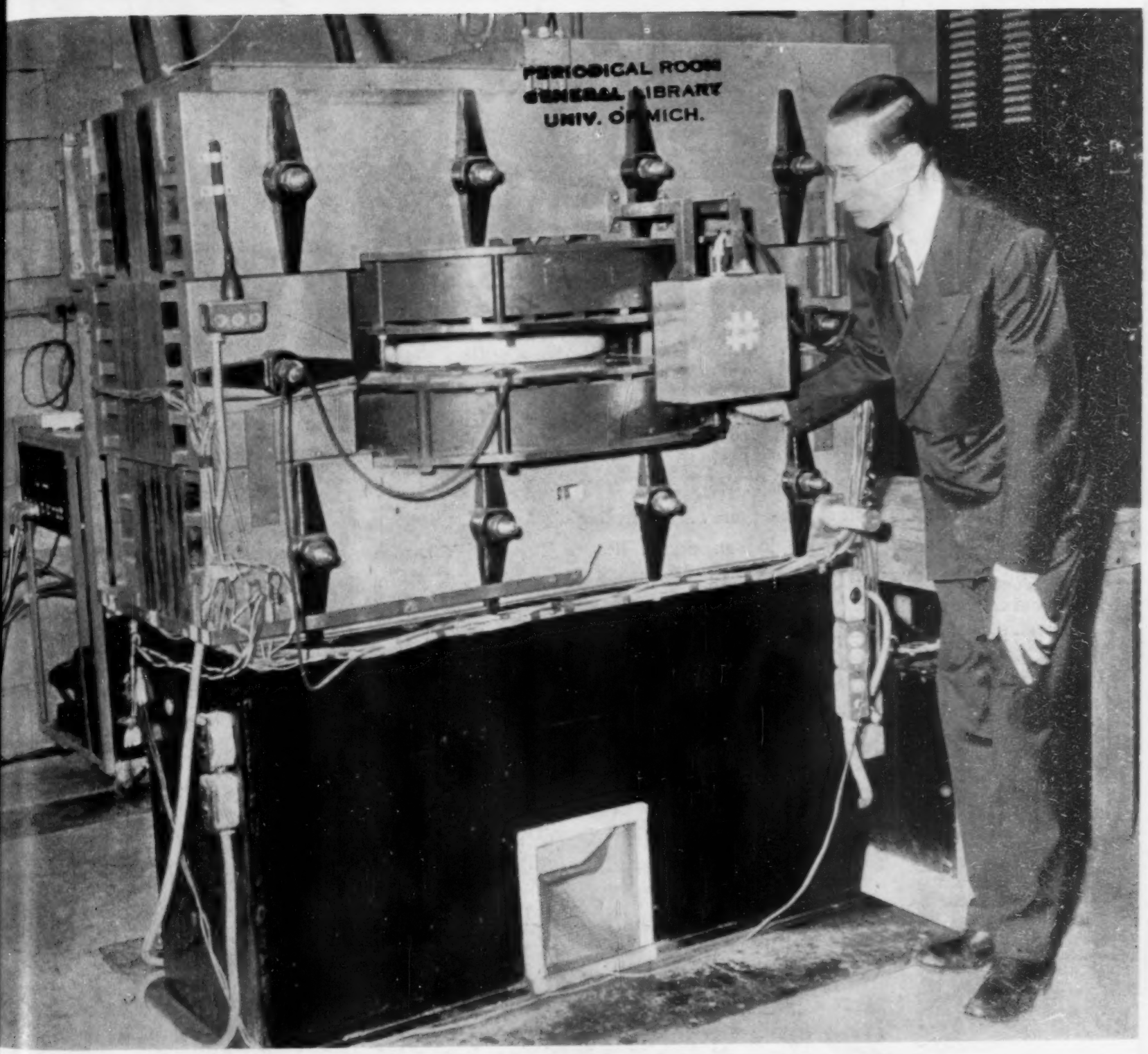
VOL. 107 • NO. 2791 • PAGES 69[illegible]-[illegible]

June 25, 1948

Science



Donald W. Kerst and the First 20,000,000-Volt Betatron

(See page 679)

INDEX ISSUE

Twice every minute the TECHNICON Pipette Washer completes its syphon-cycle . . . seven surging gallons of water to loosen and dislodge clinging residues. Wastes are then literally *swept* out of the pipettes by the violent suction set up during the brisk ten-second emptying phase.

Only the Technicon washer offers such rapidity and thoroughness, delivering in six cycles a full basketload of immaculate pipettes (capacity 200 of 1 ml in 100th's, up to 18" long). The stainless steel basket, proof against corrosive reagents, carries its load of pipettes undisturbed through every stage: cleansing, washing and drying. Requires no individual handling, no shifting from container to container, practically eliminates breakage and chippage. A *must* for the busy laboratory: let us send you Bulletin #6150 giving particulars.

THE TECHNICON COMPANY
215 E. 149 St., New York 51, N. Y.

No fuss or muss . . . pipette washing can be as easy as this

technicon

automatic **PIPETTE WASHER**

Just Published--

These Two Important

Saunders Books

Turner's General Endocrinology

New!

New!—Written for general college students, this revolutionary text is the first to present endocrinology as a biologic science. The subject is approached from an experimental rather than a clinical point of view. Attention is directed to the operation of coordinatory mechanisms in plants, invertebrates and vertebrates. Wherever possible, the human being has been chosen to illustrate the operation of biologic principles. The beautiful collection of illustrations drawn especially for this book, and the numerous charts and bibliographies will greatly simplify the teaching of general endocrinology.

By C. DONNELL TURNER, Ph.D., Associate Professor of Zoology, Northwestern University. 604 pages, 6" x 9", with 349 illustrations on 164 figures.

New—Just Ready

Schneider and Karpovich on Physiology of Muscular Activity

New Edition!

New (3rd) Edition—Up-to-date in every sense of the word, the eagerly anticipated revision of this highly regarded text describes the numerous and often delicate adjustments imposed on the body by its own activities. The applications of this physiology of exercise to today's athletic programs are clearly indicated.

Scattered freely throughout the book are many results of recent research that are significant to an understanding of the effects of exercise. Biologists and medical men who have anything to do with those who participate in strenuous athletic exercise will gain much of practical value from the book.

By EDWARD C. SCHNEIDER, M.P.E., Ph.D., D.Sc., Professor of Biology, Emeritus, Wesleyan University, Middletown, Conn.; and PETER V. KARPOVICH, M.P.E., M.D, Professor of Physiology, Springfield College, Springfield, Mass. 346 pages, 5½" x 8½", illustrated. $3.75

W. B. SAUNDERS COMPANY

West Washington Square **Philadelphia 5**

Science

Mildred Atwood, Acting Editor — F. A. Moulton, Advertising Manager

Publications Committee

Farrington Daniels, John E. Flynn, Kirtley F. Mather, Walter R. Miles, Malcolm H. Soule, Steven M. Spencer

Vol. 107 No. 2791 Friday, June 25, 1948

CONTENTS

Science and Security: *E. U. Condon* 659

Recent Discoveries in the Egyptian Faiyum and Sinai: *Wendell Phillips* 666

Obituary

Fred Conrad Koch: *Martin E. Hanke* 671

Association Affairs

Centennial Celebration Notes 673

Summarized Proceedings and Directory of Members 674

News and Notes 675

Technical Papers

Confirmatory Analysis of the "Lost" Italian Varnish: *Joseph Michelman* 679

An Experimental and Theoretical Approach to the Mechanism of Cocaine Action: *A. M. Shanes* 679

Loss of Radioactivity From Barium Carbonate Samples: *Peter E. Yankwich* 681

In the Laboratory

A Piston Recorder for Small Volume Changes: *Foster N. Martin, Jr.* 683

Radiation From a Flask Containing Various Amounts of Radioactive Phosphorus: *Russell F. Cowing* and *Egilda DeAmicis* 684

(Cover photo by Wide World Photos, Inc.)

Science, a weekly journal, is published each Friday by the American Association for the Advancement of Science at The Business Press, Incorporated, N. Queen St. and McGovern Ave., Lancaster, Pa. Founded in 1880, it has been since 1900 the official publication of the AAAS. Editorial and Advertising Offices, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Telephone, EXecutive 6060 or 6061. Cable address, SCIMAG, Washington, D. C. Entered as second-class matter at the Post Office at Lancaster, Pa., January 13, 1948, under the Act of March 3, 1879. Acceptance for mailing at the special rate postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Sec. 538, P. L. and R., authorized January 13, 1948.

Articles offered for publication should be sent to the Editor. The AAAS assumes no responsibility for the opinions expressed by contributors. Membership correspondence for the AAAS should be sent to the Administrative Secretary.

Annual subscription, $7.50; single copies, $.25; foreign postage (outside the Pan-American Union), $1.00 extra; Canadian postage, $.50 extra. Remittances and orders for subscription and single copies should be sent to the Circulation Department, AAAS, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, and 1515 Massachusetts Avenue, N.W., Washington 5, D. C. Claims for missing numbers will not be allowed if received more than 60 days from date of issue. No claims allowed from subscribers in Central Europe, Asia, or the Pacific Islands other than Hawaii or because of failure to notify the Circulation Department of a change of address or because copy is missing from the files.

Change of address. Four weeks notice is required for change of address. This should be sent to *Science*, 1515 Massachusetts Avenue, N.W., Washington 5, D. C. When ordering a change, please furnish an address stencil label from a recent issue. Address changes can be made only if the old as well as the new address is supplied.

The American Association for the Advancement of Science also publishes *The Scientific Monthly*. Subscription rates on request.

Science and Security

E. U. Condon, *Director,*

National Bureau of Standards, Washington, D. C.

THE CONFLICT OF INTERESTS WHICH arises from official secrecy regarding military applications of science and that freedom of inquiry which is necessary for the continued growth of science represents one of the most important problems of science today. By virtue of the intimate relationship between science and technology, the problem also, and inevitably, becomes one of great importance to the national welfare.

Before considering this topic, let us state what we mean by science and ask: What is its meaning for modern life? Science is the process of studying and the results of study of the facts of experience derived from a conscious program of observing, while systematically varying the factors of a given situation in order to arrive at a rational understanding of the observational data so obtained.

The scientific method is a very powerful thing. It is a new thing in human history. Its power has only gradually won recognition during the past three or four centuries of human existence. Its fairly widespread development is a phenomenon of the last 100 years. Even today the use of the scientific method is not really widespread. Vast numbers of human beings, not only in so-called backward countries but also in so-called civilized countries, have only a most imperfect understanding of what it has done and can do.

The scientific method is also restricted in its use in another way: there is still a great reluctance, even in the civilized countries, to accept and extend its use in the fields of sociology, economics, and politics. Even more important for mankind than further development of the physical and biological sciences will be, I hope, in the years to come, the full acceptance and use of the scientific method in the social sciences.

The progress we have made in the physical and biological sciences has created and revolutionized engineering technology, agriculture, and medicine. The resulting changes in the material circumstances of life have brought about enormous changes in our material way of life with respect to food, clothing, shelter, health, urban development, transportation and communication, and even the social institutions by which productive effort is carried on.

Science is also largely responsible for the techniques by which war has become vastly more destructive and all-encompassing than ever before. Today, as we have seen, major warfare requires the complete mobilization of every human and material resource of the nations that engage in it. And it results essentially in complete wreckage of the countries in which the war is fought. Let us not underestimate the destructiveness of war as it was practiced "this time," even without the use of the atomic bomb. All the death and destruction which reduced much of Europe to a shambles was wrought with old-fashioned chemical bombs.

We Americans simply do not realize what modern war would mean to us, and I am afraid that, despite all warnings to the contrary from every quarter, many of us simply do not believe the next war will mean destruction of our cities. Kingsley Martin, a distinguished British editor, was recently quoted as saying: "The fact is that for us another war is just unthinkable. I can't help believing that Americans indulge in speculation about war as freely as they do just because they are not completely terrified by the idea. They feel that there is at least a chance that it will be fought at a distance, but here we know that another major conflict means obliteration for most of us and the final destruction of Britain. We must assume, therefore, that war will be avoided in order to keep sane and get on with our jobs."

Now this situation does confront us with a difficult problem for this reason: the increasing destructiveness of wars is a terrifying thing, and the prospect of an atomic war is even more terrifying. When people are really frightened, they are less likely to act rationally than when they are serene. And we believe that rational behavior is essential to a successful approach to all our problems. But what are we to do if the facts of the situation really *are* frightening? Shall we then refrain from talking about these facts or facing the truth? I believe there is no way to deal with this greatest threat of modern war to our security than to face the facts, as calmly and courageously as we can, but also to face them squarely and honestly, trying to work out solutions to our problems in a rational way.

Address delivered before the Washington Academy of Sciences on May 20, 1948, at the Cosmos Club, Washington, D. C.

The danger of producing irrational reactions by a plain statement of the facts can be minimized if we state them in a calm and dispassionate manner. We can face up to them squarely without giving way to hysteria. In the meantime we must face the fact that we live in a world in which not much progress has yet been made toward achieving stable international relations. We are committed to a policy in which we depend on military strength to reduce the likelihood of war. This requires that a large part of our scientific effort be devoted to ends which directly or indirectly increase the military potential of this Nation. In this connection arise the difficult problems of conflict between scientific research and restriction of information about research which we wish to discuss here tonight.

The Concept of Security

The motivation behind the restriction of scientific information is simple, but the whole problem has become unnecessarily complicated and confused as a result of loose terminology, confusion as to what might be attained through a classification program, and the present fears prevalent throughout the world. Unless the problem is carefully considered and understood, however, we stand in grave danger of defeating through ignorance or stupidity the very ends which we seek to gain.

One of the ideas most closely associated with the classification of information is "security," and much of our confusion stems from the indiscriminate use of this word as well as from an ignorance of what constitutes security in the more common sense of the word. The dictionary meaning of the word security is "freedom from fear, anxiety, or care; confidence of power or safety." This is what the average man thinks of, and this is really the basic thought behind any program linked to the word.

However, there are at least two other uses of the word which are responsible for the confusion I have mentioned. The first of these is the expression "military security." Here what is meant is, clearly, the attainment of national security through military strength. In short, military security is equated to military strength. Military strength in modern society depends to a large extent on developments in science and their applications in technology. Thus, advances in science and technology are largely responsible for any security that might be achieved through military strength. This means, from this point of view, that such advances must be fostered.

The second sense in which the term "security" is now being used has to do with the classification of information, referring to the establishment of categories of secrecy and the establishment of such measures and procedures that certain types of information do not come into the hands of unauthorized persons.

This matter of keeping scientific information classified is a complicated one, and I very much fear that the public does not understand the basic problem involved in it. I cannot stress too strongly that, if we are to attain those limited objectives of security through military security, we must progress in the sciences, because military strength rests on science and because the "secrets" of science are open to any investigators anywhere if they will put forth the requisite effort. However, the subject matters of the different sciences are related, and rapid advances cannot be made unless there is considerable interchange of information among scientists in this country. Moreover, undue classification and compartmentalization may mean that large groups of scientists are working needlessly on problems which have been solved by other groups. This is an obvious waste of scientific effort and may mean a fatal delay in some particular development.

These facts are recognized by competent individuals in the National Defense Establishment and in the Atomic Energy Commission, and the declassification of information by these agencies is one indication of such recognition. However, the very real danger in the situation is that unless the public comes to realize the nature of the problem and the very sensible approaches to its solution, the public itself may guarantee our falling behind in science, jeopardizing the very security about which it is so sensitive.

The basic conflict may be stated thus: Restriction of information is designed to conserve a static position based on present knowledge. Science can grow and develop only by a wide distribution of information about its results in order to bring new young minds to bear on its problems. Although science for its own sake is a good thing, I here want to focus attention only on the slowing down of possible military application which a stagnation of science would produce. Therefore, if we adopt policies that are too restrictive with respect to our present knowledge, we stifle the growth of that knowledge. The price we have to pay in order to grow in knowledge is some giving up of present knowledge in order that we may continue to grow. From the strictly military point of view it is just as important for us to have some new secrets to keep as it is for us to hold on to the old ones. Scientific secrets deteriorate when stockpiled.

There is another point which is important with regard to this country's position in particular. If we adopt policies that are too restrictive about scientific knowledge, other countries will also do the same.

As Charles Kettering, of the General Motors Corporation, has put it, "When you lock the doors of the laboratory, you lock out more than you lock in." This result could be especially weakening to America, for we have not thus far been very productive in truly fundamental science. On the other hand, we are very well equipped to make rapid progress in exploiting technological uses of such fundamental knowledge. For these reasons we have to guard against policies that are so narrowly restrictive that we stifle our own development.

It would be most unfair if anyone who has heard me say what I have just said were to go out and say that I talked against secrecy, or that I advocated giving away the so-called secret of the atomic bomb. I do not now, and never have, held such a position. In particular, I have never advocated giving away any information about our precious atomic bomb. I have, however repeatedly stressed the point that what we could learn by research with the aid of our British friends and many valuable refugees from Hitler's Germany and Mussolini's Italy can also be learned in time by any group of scientists. And therefore, whether we like it or not, we cannot found any policy on the belief that we have anything but a very temporary monopoly in this field. It does not follow, however, that we should not hold onto this temporary advantage for what it may be worth. In the last analysis the problem of restriction is one requiring a delicate balance between the benefits of disseminating and restricting information, which only experts can determine.

Attitudes Toward Scientists

My second main point is this: Scientists are not deserving of, nor should they get, any *better* treatment than the rest of our citizenry with regard to procedures of investigation designed to pass on their probable personal integrity and reliability. On the other hand, it ought also to be admitted that scientists should not be regarded as intrinsically or à priori less reliable than the rest of our people. Yet there are those who seem to start with the assumption that a scientist is a peculiarly unstable fellow with no sense of responsibility or capacity for living according to the rules. They seem to start from the false assumption that he is guilty of incapacity in this direction unless he can prove himself innocent.

The question of personal investigation for loyalty or discretion is one on which there seems to be a great deal of confusion. I first heard the word "clearance," as a jargon word meaning permission for an individual to have access to official secrets, in the fall of 1940, when the microwave radar work was organized under the National Defense Research Committee. We all filled out long questionnaires and went to work. What was done with those I do not know. As the war went on and I became associated with other projects, I filled out more questionnaires and was fingerprinted again and again. I do not object to that, although I venture to say that millions of dollars were wasted on useless duplication of such procedures. My own position has always been that I have nothing to conceal, and if I have omitted to tell anything about myself, it was either because I thought it was irrelevant or because I could not find anybody willing to listen. A lot of the investigating that is going on today is in extremely incompetent hands and, for that reason, a waste of the taxpayers' money.

One thing that never seems to occur to some of those who worry so loudly about the discretion of scientists is that the information in question, in many instances, was not given by the Government to the scientists in the first place; rather, it was given by the scientist to his government, and, as many of us know from personal experience, it was sometimes most difficult to get the Government to listen.

The history of the atomic bomb project is an interesting case in point. News of the discovery of uranium fission reached this country from Germany in January 1939. Within a short time quite a few American physicists recognized the possibility of useful release of atomic energy and of making an atomic bomb. Then started a process of trying to interest the Government with no apparent action resulting. We physicists in the meantime voluntarily adopted secrecy policies which kept this information from the public and from other countries. After some months of frustration a direct appeal to the President was made and he saw to it that a program of work was started under the general supervision of my predecessor, Dr. L. J. Briggs. The secret was so well kept that most of the staff of the National Bureau of Standards were unaware of the existence of an atomic bomb project prior to the official announcement.

I know of no example anywhere in which a group of persons behaved in a more loyal and discreet manner than did this group of American physicists who, without clearance or loyalty probes, kept secret this important information and fought their way to the Chief Executive in order to get action. Later, of course, they were all fingerprinted and checked and rechecked before they were allowed to know these things which they had so long kept secret and about which they had to work so hard to arouse any official interest. I do not object to their being investigated this way; but I cannot help wondering what we could have done about it if we had found that some of these individuals could not be "cleared."

Detailed practices were quite different in different projects. I can only speak from first-hand knowledge of two of them: microwave radar and the atomic bomb. This brings me to the subject of *compartmentalization*. By compartmentalization in the jargon of secrecy policies is meant the policy of not allowing a man to know any more than he needs to know in order to play his part in the working organization.

The theory back of this, I suppose, is that if somehow, he should fail to be reliable, the less he knows, the less he can tell. The idea is easily applicable in military operations. Very few need to know the over-all war plans: others will be given orders covering their part when their time comes. It is conceivable that a Navy gunner does not need to know anything about the radio on his ship, and so on.

It is likewise quite true that a minor employee in a scientific research laboratory does not need to know what the over-all objective of the laboratory is. If it is his job to wire up and adjust some specialized electronic gear according to fairly explicit directions, he is not hampered in his work by not knowing what the gear is for.

The difficult problem here is to know where to draw the line. I am strongly of the opinion that the research scientist needs to feel free to get any information he wants from other branches of the research organization. There is a certain small extra risk if the man proves to be unreliable, but one more than makes up for it in the increased effectiveness with which he can work.

That there is no general agreement on policy here is shown by the fact that there are a great variety of opinions on this subject which have found official acceptance. For example, the British seem to have followed the policy of giving high-level personnel free access to anything whatever. The men, were, of course, asked not to waste their time by unnecessary visiting around, but each individual was allowed to be the judge of that. The contrast between the American and British systems was especially striking on the atomic bomb project, after our British friends came over in large numbers in the fall of 1943 to give us their help on the job. The Americans were bound by strict rules of compartmentalization. It was extremely difficult to get information from one part of the project if you were on another part, even though a clear need existed. What made matters more difficult was the fact that because of such secrecy one often did not know whether the desired information existed or where to go to ask for it. The fact that the British had no such rules was a great benefit to us Americans, for the British were able to supply badly needed data, the lack of which might have seriously delayed our work in several phases of the project. The moral here is self-evident: excessive compartmentalization threatens our own goals.

There was another amusing contrast between early British and American policies on atomic energy. In America there was for a long time a tendency to exclude all foreign-born scientists from work on the project. In Britain, however, it was felt that the atomic bomb was a very long-range project with chances of success so remote that the native British scientists could not be spared for it. So in Britain the project was at first put almost entirely in the hands of the refugee scientists.

Likewise, there was remarkable contrast between the degree of compartmentalization in the microwave radar field and that in the atomic bomb field as practiced in our American laboratories. With the microwave field at the Radiation Laboratory in Cambridge, Massachusetts, there was no compartmentalization whatever—at least, none of which I was ever aware. More than that, there were frequent secret conferences on special topics, attended by hundreds of staff members. People in all parts of the subject went to a great deal of trouble to keep those in other parts fully informed. I believe that a great deal was gained by this lack of compartmentalization in the field of microwave radar. I also think that we would have had a much harder time with the atomic bomb project had our British friends not short-circuited compartmentalization for us.

THE DISCLOSURE OF SCIENTIFIC SECRETS

This brings me to my next point—one that has often been stressed by other students of this subject. It is the *extreme difficulty of giving away scientific secrets*. I have never tried to do it, so I have no first-hand knowledge in this context. I should imagine, however, that it would be rather like teaching. All of us have experienced the teaching process as receivers, and some of us have also tried to serve on the transmitting end. Of course, if the secrecy goes so far as to include the mere fact of the existence of a project on a certain subject, such a secret can be given away without difficulty. But the amount of essential detail, even with regard to principles and especially with regard to specific designs, that inheres in any modern scientific military device is fantastically great. To give away such secrets one would have to transfer vast quantities of drawings and documents. Even those are usually so unclear without explanation that the receiver would need to be given a special course of instruction in their meaning, and this, to be really effective, requires the receiver to be a man of high scientific and technical training.

This is not to condone indiscretion or carelessness but simply to point out that giving away technical secrets is not as easy as it might seem to the uninitiated. I feel sorry indeed for any modern Mata-Hari who might be assigned to get the secret of the atomic bomb by working her wiles on a young Army sergeant.

That brings us to another point of interest. What is the actual state of espionage with regard to scientific matters? At the beginning of the war all of us scientists were warned about spies and to be careful, and I know of no one who did not take such warnings with the utmost seriousness. We were seriously in the war and were trying to help win it in every way. I do not know what experience others may have had, but, throughout the war and since, there was only one occasion on which a person attempted to obtain from me information which he was not authorized to have. In that case a foreign visitor in 1944 asked me point-blank if we were working on a uranium bomb, and I lied to him, saying that I knew of no such project.

I first heard of the Canadian spy cases soon after coming to Washington. I heard about them before the situation became public and from the President himself, who was deeply concerned about the reports he had received from Ottawa. I do not wish to condone or excuse in any way the behavior of those whose guilt was established after careful investigation and after a fair trial had been conducted in accordance with established judicial procedures. The fact that such misconduct could occur on the part of certain persons who had access to official secrets is a shocking thing. Equally shocking is the fact that the intelligence services were completely unaware of what was going on and that the cases developed only as a result of the confession of a clerk who had a most difficult time getting someone to listen to his confession. He had almost as difficult a time as did our atomic scientists in interesting their government in atomic energy in 1939.

This question of espionage in our scientific laboratories is one of the utmost seriousness. It certainly cannot be dealt with simply by assuming that every foreign visitor is a spy, unless we are prepared to cut ourselves off completely from all sources of scientific information from other countries. Moreover, we cannot follow the policies of scientific and cultural cooperation with other countries which Congress had laid down in the Fulbright Bill and the Smith-Mundt Bill and at the same time refuse to accept properly accredited scientific visitors from abroad. What needs to be done is to handle these visitors in such a way that they do not gain access to restricted information, while at the same time making their visit the occasion for building up friendly good will. It is a delicate problem which cannot be handled by sledge-hammer methods.

There has always been a great deal of romantic talk centering around espionage which seems to stem from the spy fiction which is printed in our pulp magazines. The real facts are hard to get at, because naturally this is a matter about which publicity is not helpful for those who have counterespionage responsibilities. There is one important bit of over-all information available, however, which goes beyond whatever inferences may be drawn from my own lack of personal experience with spies. It is the espionage part of the atomic bomb story that appears in the book, *Alsos,* written by Samuel Goudsmit. This book, as you know, deals with the American intelligence mission which went into Germany on the heels of our Army with the assignment of discovering what the Germans were doing about atomic bombs. Such a high priority did this mission have and so fast did it move that there were times when it might be more accurate to say that it moved in on the toes of our Army rather than at its heels.

During the war we who merely worked in the laboratories always believed that the Germans too were making a tremendous effort and that they might produce the atomic bomb before we did. This belief was a great spur to our efforts, although it is hard to say just what foundation we had for it. Knowing, however, that the Germans started with the same kind of knowledge we did and that they had been pretty good in science, at least before the Nazi regime took over, it was natural to suppose that they would work hard and effectively on this project. In addition, we heard German propaganda statements from time to time about marvelous new weapons, and we interpreted these as references to the atomic bomb. I never heard any more than that during the war, but so general was the conviction that we were in a close race that we all supposed that the people in the so-called higher echelons really had information about the situation from their intelligence reports.

The facts were quite otherwise, as Goudsmit's book discloses. The Nazis, by their methods of political terror, had so completely neutralized their best scientists and had put the management of important projects so completely into the hands of incompetents that their actual progress in this field was unimportant and negligible. So trivial was it that some of their scientists have since tried to hide their ineffectuality behind the claim that they were not trying to make an atomic bomb. This part of Goudsmit's story is pretty familiar material.

But the part of his story that I wish to call to your attention in connection with our discussion of scientific espionage is that (a) our own intelligence services

were, in fact, totally lacking in factual information about the German effort, prior to the invasion of Germany, and (b) the German scientists in charge of their project were totally lacking in knowledge concerning our effort. When Goudsmit saw them and all their official records in May and June of 1945, they had no more knowledge of our project than we had of theirs. Like us, they supposed we were working on it but lacked concrete information as to what was going on.

What lesson are we to draw from this? Espionage on both sides was certainly ineffective with regard to the atomic bomb project. Does that mean that this topic was neglected by intelligence officers, or that it was not neglected but incompetently handled, or that getting information about scientific matters by traditional intelligence methods is too difficult to be useful? I am inclined to think that the last explanation is nearest the truth.

While I am not surprised that the Germans were unaware of any specific details about our work on the atomic bomb project during the war, I am frankly quite surprised when Goudsmit tells us that they really did not even know about the Manhattan Project or what its general object was—for that was known to literally thousands of Americans.

Both for the sake of emphasis—for this is an important and serious matter—and for the sake of establishing firmly my own thoughts on the subject, let me summarize these remarks on the disclosure of scientific secrets:

First, it is extremely difficult to give away scientific secrets. The mere principles of modern scientific military developments are extraordinarily complicated, and the really valuable working details are even more detailed. To betray such secrets would require, in all probability, not only the transfer of vast and bulky quantities of reports and documents and the careful and lengthy "coaching" of an extremely well-trained scientist by an expert, but also the actual training of many men.

Second, American scientists have shown themselves singularly conscientious and discreet. In the case of the atomic bomb, we witnessed their effective and voluntary self-imposition of secrecy long before they could even get the military or the Government interested in the project. Moreover, there has not been to my knowledge a single case of breach of confidence or indiscretion by any American scientist.

I most emphatically do not say, because of our good fortune thus far, that classification and clearance measures are unnecessary, nor have I ever said this. On the contrary, I maintain that such measures are wise. I only believe that every aspect of the problem should be examined and appraised, and my comments are constructive in the sense that I believe the objectives of this Nation would be defeated if we allow *unnecessary* or *needless* regulations to hamper our progress. It is again nothing more or less than the question of balance. At one extreme there is the position of complete regulation in which, carried to its logical absurdity, every scientific development is secret and every scientist, in effect, stagnates in a vacuum-like cell of isolation—a position meaning nothing less than total disaster. At the other extreme there is the position of complete absence of regulation—a position probably most beneficial to scientific advance but unwise where military matters are involved. The sane position at present lies between the two, as our military men realize and as their policy indicates. In this, not only is advance in science involved, but also its application, for unless these advances are incorporated rather rapidly in industry, there is little benefit to the armed services. My comments are thus merely a declaration of the aspects of the problem, aimed primarily at the public which does not have the information which both scientists and our military leaders possess. Misinformed public opinion, in the present atmosphere of anxious concern, may create a situation in which our progress is impeded. It is important, then, that the public be properly informed as to the problem. This is a responsibility of scientists, of our military leaders, and of the officials of our government.

Security in the Broader Sense

Let me return briefly to "security" in its more general and civilian sense: "freedom from fear, anxiety, or care; confidence of power or safety." What a splendid thing is security, and how eagerly do all human beings crave it! Considering that every kind of human maladjustment, be it real or arising from erroneous beliefs or misinformation, gives rise to fear, anxiety, or care, we see that nearly all human difficulties could be resolved if we would only find out how to achieve security.

Kinds of security are best classified in terms of the kinds of insecurity which deprive us of feeling secure. These may be grouped into four main headings: (1) anxiety of the individual concerning his place within the social groups to which he belongs, (2) anxiety of minority groups concerning their place in the national community, (3) anxiety of the national community as a whole concerning avoidance of economic depression, and (4) anxiety of the national community concerning avoidance of war with other such groups.

All of these are very real, often bitterly tragic, anxieties. Perhaps the most bitter and the most compelling one now is the last—in a period which has

seen two major wars and scores of so-called "minor" wars in less than half a century. This anxiety today weighs down every civilized human being in the world; it is this anxiety beside which all others seem trivial.

Security with regard to avoidance of war cannot be assured by purchase of military equipment or any amount of research in applications of physical and biological science to military technology. This is not to argue against such efforts, but to warn against too exclusive a reliance on their efficacy. The entire documented history of man stresses the danger and folly of such reliance. The only way to security in international relations lies in a devotion to study of the social problems confronting mankind as a whole. This calls for an undreamed of development of all the social sciences and their application to social problems in a spirit of high responsibility. It calls for an approach to such problems which is not limited by traditional thinking in terms of group rivalries of any kind. It will not be easy, just as it is not easy to develop supersonic jet planes and guided missiles.

Getting down to the particulars of the present situation, we should recognize that there is no defense against the atomic bomb. There is no defense against ordinary bombs, for that matter, as the cities of Europe clearly attest. The old cliché that there is always a defense to every weapon of offense should be revised to read "there is an *attempted* defense to every weapon of offense."

What kind of attempted defenses against the atomic bomb have been proposed? These are: (a) neutralization of use by fear of retaliation, which is the commonly accepted view as to why poison gas was not used in World War II, (b) interception of the means used for delivery, which there is at present no reason to hope will be much more effective than in the last war; and (c) decentralization of our cities, to reduce the size of targets and make the use of atomic bombs "uneconomic" for the attacker, which would call for a complete revision of all real property values and complete dictatorial control in order to effectuate such decentralization. I have no confidence in any of these. Psychological neutralization is an unstable and uncertain hope, wholly dependent on errors of calculation and whims of judgment on either side. As to interception, there is negligible possibility of effective interception of such weapons smuggled in in peacetime and little hope of effective interception of delivery by bomber planes. To make decentralization of cities effective would require that Americans submit to government controls during peacetime, long in advance of outbreak of actual war, such as they have never submitted to even in wartime; and therefore it simply will not be done in the kind of America which we hope to preserve.

In short, the greatest contribution to real security that science can make is through the extension of the scientific method to the social sciences and a solution of the problem of complete avoidance of war.

This means that we must be willing to invest the time, the people, and the funds in developing and applying these methods. If we feel the short-range security that military strength provides valuable enough to spend approximately 17 billion dollars next year, we should be prepared to sacrifice in a commensurate manner for those activities which alone give hope of the avoidance of war. Thus, we should not balk at $0.3 billion for Federal aid to education, which promises us better, wiser, more productive citizens; or at $0.010 billion for a National Science Foundation, designed to embrace fields presently overlooked; or at $0.007 billion for UNESCO. In the years since the end of hostilities in August 1945 we have seen a steady deterioration in certain parts of our foreign relations and a gradual resignation to the point of view that another war is, if not inevitable, at least probable. It is reasonable to ask, at this junction, the question which John Winant asked his audience at his last public appearance before his death last autumn: "Are you doing as much today for peace as you did for this country and civilization in the days of war?" "I'm not," he answered for himself and committed suicide two weeks later.

Perhaps man, with his relatively short history, has neither learned his lessons well nor progressed far enough intellectually and spiritually. Perhaps his history for some time to come will be an unhappy and tragic one. This is our problem. It will not wait, nor can it be evaded.

Recent Discoveries in the Egyptian Faiyum and Sinai

Wendell Phillips, *Leader*
University of California African Expedition

THE EGYPTIAN PHASE OF THE University of California African Expedition under the direction of William B. Terry, expedition field executive, arrived at Alexandria on August 28 through the courtesy of the U. S. Navy.[1] During the following 6 months of operations in Egypt two subsequent ships unloaded additional scientists and equipment, giving the Egyptian Phase a total of 27 scientists and technical experts, exclusive of local personnel, and in addition, an airplane, motor boat, and 13 motor vehicles.

The specific objectives in Egypt were varied and depended to a great extent upon the geographic localities involved and specialized personnel available to conduct the extensive programs in paleontology, physical anthropology, prehistoric and historic archaeology.

The varied scientific programs have been made possible by the constant support and technical excellence of the following members of the expedition: Ahmed Lutfi, representative of the Service des Antiquités; Gladys Terry, business manager and secretary; Capt. G. G. Edwards, USMC, Chief of Motor Transportation; Dr. Rodman Wilson, MCR, USNR Physician; M/Sgt. Charles B. Evans, USMCR, motion picture photographer; M/Sgt. James Houle, USMC, Motor Transportation; Capt. George Russel, USA geographer; David Cohen, scientific and technical assistant; and Walter Thompson, technical assistant.

Faiyum Desert Programs

Paleontology. The paleontological program was conducted by Robert Denison, curator in the Dartmouth College Museum; P. Deraniyagala, director, National Museums of Ceylon; V. L. VanderHoof, professor of geology, Stanford University; and H. B. S. Cooke, senior lecturer in geology, University of the Witwatersrand.

The program in vertebrate paleontology was initiated with a reconnaissance trip into the desert area north of the Faiyum depression, at which time a practicable route of ascent up the steep escarpment of Eocene beds near Qasr el-Sagha was found. The Oligocene beds above the escarpment were examined over a wide area and some of the bone pits of earlier expeditions located.

A second reconnaissance trip involved a more careful study of the lower Oligocene Qatrani beds and confirmed the views of Beadnell (1905) that the upper part of the Oligocene fluviatile deltaic and marine beds was relatively barren of fossils, and that abundant vertebrate fossils were found only in one bed near the base of the series, associated with numerous silicified tree trunks. The earlier parties of Beadnell, Margraf, and Granger had apparently rather effectively cleared the whole region of surface fossils, and it was eventually decided that an area in which these parties had already worked extensively still offered the best prospect for further excavations.

After the expedition headquarters had been moved from the Egyptian government's excavation house near the pyramids of Giza to Kom Aushim (ancient Karanis) near the Faiyum, daily collecting trips were made to the Upper Eocene Qasr el-Sagha beds. This produced a fair collection of moeritherium, sirenian, crocodilian, and fish material with a good stratigraphic sequence of invertebrates.

Field camp was established near the old bone pits about 8 miles W.N.W. of Qasr el-Sagha. Since these beds had not been worked for nearly 40 years, it was thought that they would be productive to further collecting. It soon appeared that this was not the case. Erosion is almost entirely subaerial and is extremely slow because of the protective mantle of desert rubble. Careful prospecting and a large number of exploratory trenches finally revealed one large and one small deposit of bones which were excavated as far as practicable. These apparently accumulated in pools in the flood plain or delta of a large stream. It is possible that the pools were formed through blocking of the stream flow by the

[1] The author wishes to express his appreciation in the name of Dr. Robert Gordon Sproul, president of the University of California, to his Majesty, King Farouk I, to His Excellency Nokrashi Pasha, the Prime Minister, and to General Abd el-Hamid Bey Zeki, the Governor of Sinai, for their generous cooperation, assistance, and personal interest in all the activities of the expedition.

The southern phase of the University of California African Expedition, which is operating in South and Southwest Africa under the supervision of Charles L. Camp, director of the Museum of Paleontology, University of California, includes the following specialists (all from the University of California with the exception of George P. Barbour): Frank Peabody, paleontologist; Edwin M. Loeb, ethnologist; Mrs. Laura Bolton, musicologist; Charles Camp, Jr., assistant musicologist; Thomas Larson, research associate in zoology and archaeology; Robert Rodin, botanist; Brois Ifiund, psychologist; and George P. Barbour, geomorphologist (professor of geology, University of Cincinnati).

large tree trunks which occur so abundantly in this bed. The fauna includes fishes, crocodiles, and turtles which lived in the stream, a large variety of mammals which must have been washed downstream, and a few sharks and rays which may have lived in the estuary and come upstream at times. The pits and surface finds furnished a good representation of the fauna, which includes among the mammals hyracoids, anthracotheres, hyaenodonts, proboscideans, and *Arsinotherium*. The area near the pits was geologically mapped at this time.

Work was planned for the Lower Miocene beds at Maghra, 135 miles west of Cairo, from which *Dryopithecus* has been reported. Owing, however, to the presence of land mines in this area, the project had to be abandoned.

In the area 60 miles W.S.W. of Kom Aushim, called "Zeuglodon Valley," numerous remains of *Prozeuglodon* and *Dorudon*, primitive whales, are to be found in the Upper Eocene Birket Qarun Series. Skulls and skeletal remains of both genera were collected, as well as elasmobranch, turtle, and invertebrate material.

A brief reconnaissance trip was carried out in the area from the southern end of the Wadi Natrun (half way between Cairo and Alexandria) into the Wadi el-Farigh in the hope of collecting Miocene and Pliocene vertebrates. Exposures were found to be poor and bone too scarce to encourage vertebrate collecting, except possibly in conjunction with an extensive stratigraphic survey of the area westward to Maghra Oasis, and time did not permit such an undertaking on this expedition.

Upon the completion of the Faiyum program, the Paleontological Section of the expedition in Egypt, under H. B. S. Cooke, began the overland journey through Upper Egypt and the Sudan and across Uganda to the second major headquarters at Nairobi, Kenya Colony.

Prehistoric archaeology. This program was conducted by S. A. Huzayyin, professor of geography at Farouk I University.

The Faiyum Depression forms an exceedingly interesting geographical unit, partially isolated by the surrounding desert, but formerly in direct contact with relatively dry grasslands and semideserts in Libya. In most periods it has also been connected by a waterway, natural or artificial, with the Nile Valley to the east. It has thus attracted much attention on the part of prehistorians and paleogeographers. More than 40 years ago Beadnell made a general geological survey of the Faiyum Depression, but devoted more time to the Tertiary than to the Quaternary. Attention was focused on the latter during the period between the wars by Sandford and Arkell, working on behalf of the Oriental Institute at Chicago, and especially by Misses Caton Thompson and Gardner.

It was decided that the expedition should start its investigations on the rather inaccessible northern border of the Depression, especially near the Qatrani Escarpment.

Sandford and Arkell had devoted themselves 20 years ago to the eastern side of the Depression and the Nile Faiyum Divide, while Caton Thompson and Gardner have emphasized the late Pleistocene and Recent physiography and archaeology of the lowest levels around Birket Qarun.

A large number of streamlet terraces were discovered in the Qatrani region, containing many flint implements which can be assigned definitely to the Upper Paleolithic, *i.e.* to the late Pleistocene. Altogether, 21 of these terraces and gravel deposits were studied and excavations to determine their formation and date carried out at a number of points. Fortunately, implements were discovered *in situ* in the terraces, and these can be assigned to the Upper Paleolithic.

Since only two or three of these terraces had previously been recorded at all (by Beadnell in 1902–05), the new material is not only far more abundant, but it can be dated much more correctly. Beadnell dated them as late Pliocene or Pleistocene. It is expected that careful study of the gravel deposits in question, as well as of the flint artifacts found in them, will throw valuable light on both the physiography and cultural evolution within the Faiyum Depression. It is already certain that the conclusions of Beadnell, as well as those of Sandford and Arkell, will have to be considerably modified on the basis of the much clearer picture which is now available of the chronology and physiographic development of the Faiyum Depression.

From an archaeological point of view, the industries discovered are also of distinct interest. From the middle of Upper Paleolithic onward, the Faiyum Depression was the center of a flourishing civilization which has more than one facies. A number of sites were located and excavated running from the Upper Paleolithic to the late Neolithic stages. When these archaeological finds are well studied, it is hoped that fresh and illuminating light may be shed on the evolution of the Neolithic of the Faiyum from Upper Paleolithic. It is possible that this may prove to be one of the first instances of a definite technological connection between the Paleolithic and the Neolithic cultural stages.

Physical anthropology. This program was conducted by Henry Field, former curator of the Field Museum of Natural History, Chicago.

Anthropometric data and measurements were recorded on 189 men at Tamiya, in the northeast part of the Faiyum. This village of about 9,000 inhabitants was selected for study because of its accessibility to Kom Aushim, the base camp, and because Dr. Saleh ed-Din, the local medical officer, was interested in research, spoke good English, and was anxious to collaborate. The subjects for examination were drawn mainly from the cotton-ginning plant. Photographs, both frontal and profile, were taken of the majority of the subjects and of a general series of villagers, especially children.

Shortly after the work began, it became desirable to have medical (particularly blood grouping and parasitological examinations), nutritional, and sociological collaborators in order to obtain a more accurate and broader picture of the community. Mohammed M. Sadr, biochemist in the Department of Nutrition, School of Medicine, Kasr el-Aini, approved this plan, and through Mezni Bey, in the Department of Public Health, it was proposed that a government mobile nutritional unit be sent to Tamiya for about 8 weeks to collaborate on the survey of Tamiya and thus to make it the key study for the Faiyum. Five days later the Minister of Public Health sent a nutritional unit to Tamiya—a record for speed and efficiency anywhere. Dr. Sadr supervised the work throughout the following two months, making at least biweekly trips to Tamiya from Cairo. As a result, 900 individuals were examined, 150 households analyzed in great detail, 180 blood samples taken, medical data recorded, a careful nutritional survey completed, and sociological notes recorded (by Sitt Fatma, since only a woman can obtain this type of material from the *fellahin* women). Dr. Sadr changed his staff of 6 midway through the study in order to eliminate the human equation and so that he could compare the two sets of results, sometimes from the same families. Fortunately, the two series showed a good degree of homogeneity.

As a result of this joint project at Tamiya a combined anthropometric-medical-nutritional-sociological survey has been completed. When the conclusions have been drawn, it should be possible to make certain definite recommendations for the improvement of the public health of Tamiya, which may well become the most envied village in the Faiyum. Furthermore, by its very example, Tamiya may be the means of improving the general health of the entire community.

About the middle of February a reduced number of measurements and observations were recorded upon 306 men in Fidimin, the garden village of the Faiyum. Thus, the total number of males measured in the Faiyum was 495, and about 650 racial-type photographs were taken.

Sinai Peninsula Programs

Prehistoric archaeology. The northern program was conducted by S. A. Huzayyin and the southern by Henry Field.

One of the major objectives for Sinai was to discover Paleolithic flint implements which might furnish a cultural link between Egypt and Palestine and, in a wider sense, between Africa and Asia. The importance of Sinai in this respect was always surmised, but never before were stone implements systematically searched for in this important area. Such a program was essential to settle such controversial points as whether certain cultures started in Asia and spread to Africa or whether Africa was their place of origin. In this respect it was fortunate that a series of open-air sites which had at one time been used as factories for flint tools was discovered. The most important of these flint mines, found at Rawafi, in the Wadi el-Arish in northeastern Sinai, had been exploited by man since the closing stages of the Lower Paleolithic (Acheuleo-Levalloisian) times. This new site at Rawafi, representing a large quantity of artifacts including hand-axes (*coups-de-poing*), is now one of the most important surface settlements in southwestern Asia and is the most important Paleolithic station yet discovered south of the Bethlehem area in the Sinai-Palestine Region.

Exploration of the northern part of the Tih Desert between Gebel el-Halal and the region of Suez yielded Upper Paleolithic flints in a number of areas, showing an interesting local industry with both African and Asiatic affinities. Isolated finds in northern Sinai included a site near Km. 115 from Ismailia with a large number of beautifully flaked microlithic lunates reflecting a Mesolithic culture which flourished between 8000 and 5000 B.C., again intermediate between already known flint industries in Egypt and Palestine. Since these were found within a small area, it was deduced that this must have been a flint-knapping site. It has been suggested that these microlithic crescents were tips for reed shafts which served as arrows.

After leaving Bir Hasanah and Nekhl, the expedition proceeded to the western coast of Sinai, where headquarters were established from December 24 to January 17 at Abu Zeneimeh.

A small rock shelter in the Wadi Khreze, off the Wadi Feiran, yielded late Chalcolithic tools and large basalt pounders, probably for use in the three turquoise mines some miles distant in the Wadi Ma-Kuttab. Trial trenches revealed that this shelter had been used not only by generations of ancient miners but also by recent nomads with their sheep and camels.

Near the entrance to the Wadi Ba'ba'ah, on a low flint-covered terrace bisected by a small dry stream, a remarkable Upper Paleolithic industry was discovered. This industry, of singular character, was contained in a 20-foot terrace near the junction with the Wadi Shellal.

An interesting series of stone picks was collected from the small wadis immediately north of Serabit el-Khadem. Flint implements, presumably for working the local sandstone, were also found in these wadis, washed from the Temple area in the now rare times of flood. It now becomes clear that the natives of Sinai had begun to mine turquoise here before the Egyptians took over the exploitation of the area themselves.

The implements represent typologically several phases from the Paleolithic to the Neolithic periods; those from nearest to the Nile valley show African affinities; those to the east, Asiatic links. Thus, Sinai is truly the ancient intercontinental zone of migration and the land bridge between Asia and Africa through which passed ancient man in various Stone Age cultural phases.

Historic archaeology. This part of the expedition, which was conducted by W. F. Albright, professor of Semitic languages, Johns Hopkins University, was fortunate in having the following Fellows of the American School of Oriental Research in Jerusalem added to its staff in southern Sinai: John C. Trever, Drake University; William H. Brownlee, Duke University; and William H. Beling, Princeton University.

One of the most significant new contributions from southern Sinai was the discovery of a small Egyptian seaport in the Merkhah region, south of Abu Zeneimeh. This seaport, situated only 100 meters from the water line and about 5 meters above the mean Red Sea level, had served as the outlet for ancient Egyptian mining expeditions from Serabit el-Khadem. Broken pottery was distributed over the surface, covering an area of 50×100 meters, and can be dated about 1500 B.C. or a very little later, in the period of Hatshepsut and Tuthmosis III. Soundings were made which clearly demonstrated that the debris of occupation had been almost completely removed by wind action.

In the recent past there has been much debate about the ancient shoreline of the Red Sea, both in the Suez and in the Aqabah region. The late Hermann Guthe and others tried to prove that, as a result of rise of the land or fall of the sea (presumably the former), the northern ends of the two gulfs and the adjacent coastlines ran much farther inland in early historic times than they do today. According to their view, the northern end of the Gulf of Suez was approximately at the northern end of the Bitter Lakes today, while the northern end of the gulf of Aqabah covered about a fourth of the road going north from the town of Aqabah to the Dead Sea.

Discovery of the ancient site of Tell el-Kheleifeh, near Aqabah, and its partial excavation in 1937–40 by Nelson Glueck, on behalf of the American School of Oriental Research in Jerusalem, demonstrated that the northern shore of the Gulf of Aqabah about 1000 B.C., when that site (Biblical Ezion-geber) was founded, was certainly where it is today (or even farther south), since Tell el-Kheleifeh is situated only a few meters above sea level and 550 meters from the sea. The work at Merkhah now proves the same thing for the northern part of the Gulf of Suez, even more strikingly, since the ancient site is lower, nearer the sea, and goes back at least 500 years earlier. It now becomes certain that the route of the Israelite Exodus, described in the Bible as passing from Rameses (San el-Hagar) through Pithom and Succoth (Tell el-Maskhutah west of Ismailia), cannot have passed through what we call the Red Sea but must have been farther north, through the body of water called "Lake (or Sea) of Reeds" in both Biblical and Egyptian records of the 13th Century B.C. (the approximate date of the Israelite Exodus).

The second significant contribution came from the study of the Egyptian turquoise-mining site at Serabit el-Khadem. Since many archaeological expeditions have studied the site for more than a century, this expedition did not expect to make any significant contribution during the short stay allotted. The explorations and excavations of Sir Flinders Petrie during the winter of 1904–05 seemed to have exhausted major possibilities, especially since three Harvard expeditions (1928, 1930, and 1935) had found only gleanings and two other expeditions had uncovered even less. However, in 1905 Petrie had discovered a number of very early alphabetic inscriptions in an unknown script at Serabit. Ten years later Alan Gardiner published them, proposing an interpretation of one or two words which was accepted by many other scholars and which formed the basis of nearly all attempts at decipherment during the past quarter-century. Gardiner thought that these letters represented the original symbols out of which all our later Semitic and European alphabets have developed. This original alphabet was, he believed, invented on the acrophonic principle, where the initial consonant of the name of the object denoted by the symbol was employed as the phonetic value of the symbol in question, e.g. a house is *bait* or *bet* in Semitic, and the picture of a house was accordingly taken to represent the consonant *b* (*beth* in Canaanite, *beta* in Greek). A very serious obstacle to correct decipherment has been the small number of inscriptions known and uncertainty as to their date and purpose. The first difficulty has been partly removed

by finds of additional inscriptions since 1905 (the last made in 1936). Petrie proposed a date for the inscriptions (about 1500 B.C.), but this was rejected by Gardiner and nearly all other later investigators. The recent investigations of the Sinai expedition have now definitely established the correctness of Petrie's date. On the other hand, previous investigators were definitely wrong about the function of most of the inscriptions, which are now shown to be mortuary (*i.e.* having to do with observances and practices connected with burials). Moreover, it has generally been assumed that the miners who wrote these inscriptions were local Bedouins, whereas mining experience has consistently shown that local Bedouins cannot be used as successfully in this kind of work as labor from sedentary agricultural regions. In antiquity, mining conditions were so bad that only conscripted or forced labor could be used. It now appears that the documents were written for mortuary purposes by miners from Canaan (pre-Israelite Palestine and Syria) in good Canaanite (now known from cuneiform inscriptions discovered for the most part since 1929). All of the inscriptions which are sufficiently well preserved can now be interpreted, and at least two-thirds of the characters can be identified, confirming Gardiner's acrophonic theory in the most striking way possible. The chief reason for previous failure is now evident: there was not enough evidence for grammar and vocabulary, and efforts to read the documents as Biblical Hebrew could not possibly succeed since they were actually written in Canaanite.

Although there are three short inscriptions from Palestine which are considered slightly older, these proto-Sinaitic inscriptions from Serabit el-Khadem form by far the oldest collection of documents in our own ancestral alphabet.

Physical anthropology. Henry Field, who conducted the physical anthropology program in the Faiyum Desert, also directed the program in Sinai.

One of the major purposes of the reconnaissance in Sinai was to collect anthropometric data on the Bedouins. Since there are few published figures (cf. Chantre) on these people for comparison with the nomads of southwestern Asia, every effort was made to obtain a series of individual measurements, observations, and photographs, all based on the Harvard system.

Anthropometric data were recorded on 223 males, including 73 Jebeliya, 29 Qararshe, 29 Sawalha, 23 Terabin, 22 Muzeina, 22 Tiaha, 12 Wulud Sa'id, and a few individuals from several tribes. The analysis of these statistics, including the morphological characters, and especially the front and profile photographs, will shed new light on the racial composition of the nomads of Sinai. As a result it will now be possible to make comparisons with the desert peoples of Syria, Trans-Jordan, and Iraq to the east, and certain groups already studied in Egypt to the west of Sinai, especially in Sharqiya Province. The Bedouins were extremely friendly and cooperative, the main difficulty in obtaining a large series lying in the fact that their tents are so few and far between.

A series of 19 skulls from one of the beehive tombs (*nawamis*) in the Wadi Solaf in southwestern Sinai were measured and photographed. After examination, they were replaced and the tomb resealed. In addition to these anthropometric data, tribal information was recorded and many photographs of Bedouin life were taken.

Tropical Medical Research

Immediately preceding the departure of the remaining section of the Egyptian Phase to the Sudan, under William B. Terry, additional members of the expedition arrived to conduct an extensive research program in the study of African tropical diseases for the U. S. Navy. These included Cdr. J. M. Amberson, MCR, USNR, physician and surgeon; Ernst Schwarz, zoologist; Cdr. Trenton Ruebush, USN, parasitologist; Harry Hoogstraal, mammalogist and entomologist; Deaner K. Lawless, CPhM, USN, assistant parasitologist; and Harley F. Cope, Jr., PhM 2/c, USN, aerial and medical photographer.

In addition to providing medical aid to members of the expedition, these specialists are to obtain information concerning general health conditions, tropical diseases, parasites, and animal carriers of infection.

Extensive zoological collections of various animal groups for research and medical purposes will be made. An essential point in the program will be the study of the ecology and distribution of reservoir hosts —in particular, of commensal rats.

An effort will be made to obtain for study in the laboratory new strains of protozoa and bacteria that produce disease, and to find and bring back animals that can be developed into laboratory animals to suit special lines of research.

Field trials will be conducted, using the most newly developed drugs to determine their efficacy in the prevention of tropical diseases.

Obituary

Fred Conrad Koch
1876-1948

Fred Conrad Koch, Distinguished Service Professor Emeritus of Biochemistry at The University of Chicago and director of Biochemical Research, Armour & Company, died suddenly on January 26, 1948. Dr. Koch was an internationally known biochemist and one of the most highly esteemed scientists of the Chicago area.

Born in Chicago, May 16, 1876, he spent most of his childhood in Elmhurst, Illinois. After graduation from Oak Park High School, he attended the University of Illinois, where he received the B.S. degree in 1899 and remained as instructor in chemistry for two years. In 1902 he accepted and held for 7 years a position as research chemist at Armour & Company in Chicago. Feeling the need of more fundamental training, he applied for a graduate fellowship at The University of Chicago in 1909. A. J. Carlson has reminisced about the hesitation of certain members of the faculty committee in awarding a fellowship to an applicant who was 33 years old. Their wisdom in making the award has been borne out by subsequent events. Working in the Department of Physiological Chemistry under the direction of A. P. Mathews, Koch received the Ph.D. in 1912 and then remained in the Department, first as instructor, later as professor, and finally as Frank P. Hixon Distinguished Service Professor of Biochemistry. He served as acting chairman after Dr. Mathews left the University in 1919 and was named chairman of the Department in 1926.

Although he reached the age of retirement from the University in 1941, his active mind and body were in no way ready for rest. Rejoining the staff of Armour & Company, and free from the duties of teaching and administering a department, he continued his researches with unprecedented vigor and enthusiasm. When, after a heart attack in 1946, he was advised by his physicians to relax, he tried to put in fewer hours each day and managed to take longer and more repeated excursions to his summer home in Wisconsin; but it was difficult for a man with his vitality and enthusiasm to slacken his pace. While recuperating at home during his last week, he had conferences with his research associates. He died "with his boots on."

Dr. Koch's research interests cover a wide range of subjects chiefly in the fields of hormones, vitamins, enzymes, and quantitative analytical methods. His work on the male sex hormone is probably the most spectacular and best known of his achievements. In 1926, with L. C. McGee, he first demonstrated male hormone activity in extracts of bulls' testicles; later he developed methods for extracting the hormone from human urine. With T. F. Gallagher he developed a quantitative method for the assay of the male hormone, based on the increased size of the capon's comb, which was widely used and which finally led to the isolation and synthesis of androsterone by Butenandt in 1931, and later also of testosterone and other androgens. In collaborative studies with zoologists and physicians he guided many studies on the physiology and clinical use of the male hormones. Other research interests have included secretin and other gastrointestinal hormones, thyroid and pituitary hormones, pepsin, rennin, trypsinogen activation, and vitamin D's. In collaboration with his wife Elizabeth Miller Koch, the conversion of heat-treated cholesterol into provitamin D was orginally observed in 1925. Among his widely used inventions are the Koch pipette, a stopcock pipette with reservoir, and a modified form of the volumetric amino nitrogen apparatus. In the field of blood and urine analysis his micro-Kjeldahl method for total N estimation and his enzymatic uric acid method are best known. He is author of a valuable teaching manual, *Practical methods in biochemistry*, which has appeared in 5 editions.

Dr. Koch's greatest influence was as a teacher and trainer of biochemists. Many of the 40 Doctors of Philosophy and 20 Masters of Science who earned their degrees under his direction occupy places of responsibility and distinction in leading educational and research institutions of this country. Hundreds of medical and other science students have profited by his clear exposition, his conservative thinking, and his insistence on the quantitative approach to biological questions. The excellent arrangement of the physical facilities of the Department of Biochemistry in Abbott Hall is due largely to his planning, and many of his ideas were adopted by other departments and institutions in the construction of their new laboratories. The annual departmental teas, held each autumn in the Kochs' apartment at 1534 East 59th Street, were, for returning and current students and staff, an occasion of friendliness and charm, to be cherished and long remembered. In 1939, students and friends contributed toward a bust of Dr. Koch, which was presented to the University and which stands in the biochemistry lecture room in Abbott Hall, a symbol of respect and affection.

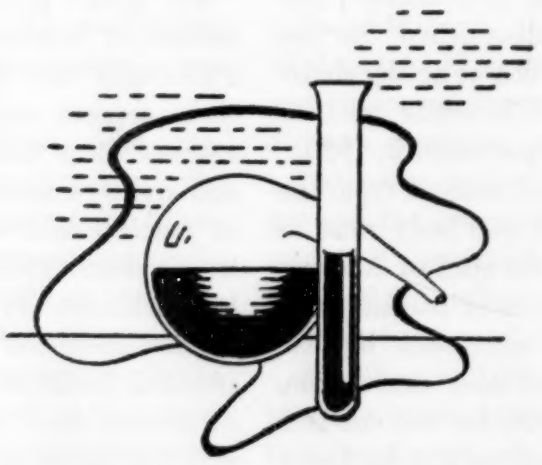
His long record of distinguished service was recognized by the award of many honors, both at home and abroad. He had been Harvey Society lecturer, Julius Stieglitz Memorial lecturer, president of the Association for the Study of Internal Secretions, councilor and secretary of the American Society of Biological Chemists, general chairman of the September 1946 National Meeting of the American Chemical Society, and, for the Chicago Section, Willard Gibbs juror, vice-chairman and director. In 1935 he was chosen one of this country's delegates to the League of Nations Conference on Standardization of Sex Hormones. At the invitation of the Uruguayan government in 1941, he was this country's representative at the Pan-American Congress on Endocrinology. In 1942 he received the Squibb Award of the American Association for the Study of Internal Secretions; in 1943, the annual award of the Chicago Chapter of the American Institute of Chemists. He was an editor of the *Archives of Biochemistry*. In 1947 he was elected vice-president of the Institute of Medicine of Chicago.

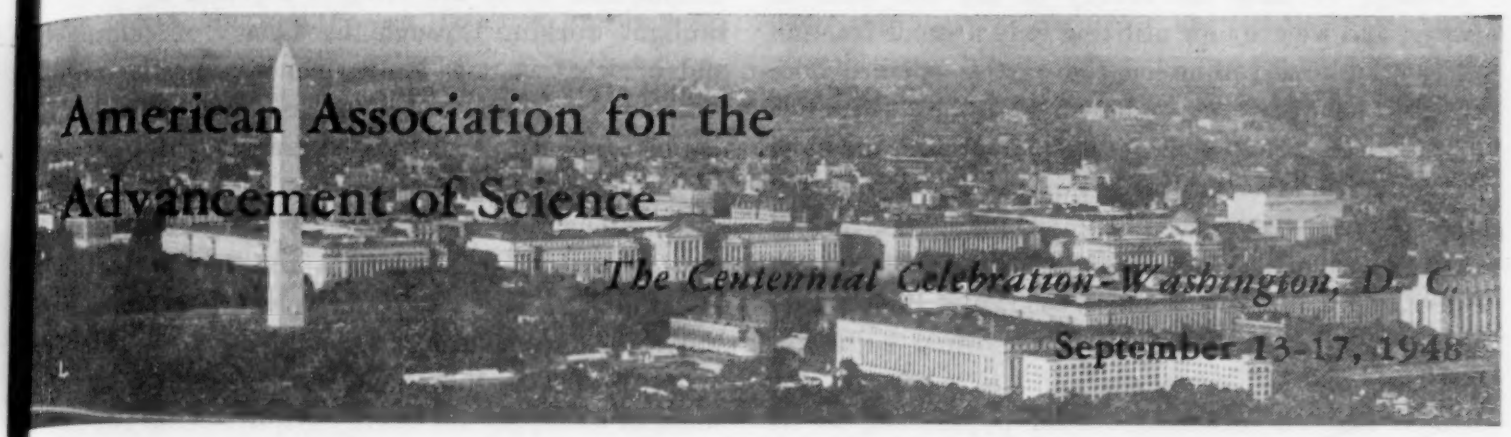
A devoted companion in his scientific as well as his personal life was his charming wife, also a chemist and Ph.D., who collaborated with him in several scientific studies. Both were interested in symphonic music and were trailer and camera enthusiasts. They traveled the length and breadth of the land by automobile and often entertained friends with pictures of their wide travels. In recent years they were increasingly attached to a summer home in Wisconsin, the development of which, although delayed by building restrictions, provided much joy and relaxation.

Fred Koch was outstandingly orderly and punctual. Throughout his laboratory, his office, and his home, systematic planning and efficient arrangement were in evidence. Although he was ready for most radical development in his scientific research, in his social and political thinking, and in his teaching methods, he was conservative. His unselfish devotion to the problems of others, often at the expense of his own interests, has left a great feeling of debt and appreciation among those who sought his advice and help. His exemplary speech and conduct, his good humor, his refinement and good taste, and his wide interests, won for him a host of friends and admirers. He will probably be remembered best for his scientific accomplishments, for his self-sacrificing and energetic devotion to his work and to his students, and, most of all, for his personal and scientific integrity.

MARTIN E. HANKE

The University of Chicago





Symposium on Problems of the Ocean

Among the dozen or more symposia to be held during the Centennial Celebration of the AAAS is one on Problems of the Ocean. Oceanography, which includes the study of the physical, chemical, and biological conditions of the ocean, and which overlaps allied fields such as meteorology, geology, etc., has made rapid progress in the last decade. These advances range from those that have immediate and important practical application to those that aim primarily at adding to the sum total of human knowledge. However, there is need for a much better understanding of the phenomena of the oceans. This is emphasized when, in the present state of the world, these great bodies of water must be considered as connecting links rather than separating barriers, and when it is also clear that the rapid rate of increase in human populations requires an expanding dependency on marine resources, *i.e.* the resources of perhaps the only major area which is not yet fully exploited.

Early oceanographic expeditions obtained empirical information on currents, temperature, waves, and other phenomena. There followed notable advances in devising physical and chemical theories to explain the distribution of properties found in the ocean, but at the present time these fall far short of actually accounting for existing conditions. Theory and experiment will undoubtedly provide explanations and methods for predicting time changes and for extrapolating knowledge into the depths and other areas thus far essentially unexplored. However, this goal is still far in the future. Because of the complicated nature of the interrelationships that exist in the ocean it is at present necessary in many cases to turn to empirical correlations to meet immediate demands.

Although fundamentally unchanging, the oceans are never at rest, nor is the distribution of properties ever twice exactly the same. Within limited areas and over short intervals of time, conditions change to a degree that exerts great influences on the organisms living in the sea, on the atmosphere, and on the coasts and sea bottom. Because of these facts the close interrelationship between the various phases of oceanographic research, and their mutual dependence on related fields of endeavor, have long been recognized.

The themes of the three speakers at this symposium represent the major bases on which the science of oceanography rests. Carl Eckart, director of the Scripps Institution of Oceanography at La Jolla, California, will discuss the theory of stirring and mixing; it is ordinarily thought that stirring and mixing can occur only in turbulent motion, but closer examination shows that relatively simple motions also result in stirring. Richard H. Fleming, chief of the Division of Oceanography, Hydrographic Office, U. S. Navy Department, will describe the requirements for surveys and the various applications of oceanographic information. Daniel Merriman, director of the Bingham Oceanographic Laboratory, Yale University, will talk on the biological problems of the ocean. The symposium will conclude with comments from the floor by several principal discussants and such members of the audience as are interested.

Symposium on Sources of Energy

This symposium will include "Energy From Fossil Fuels," by M. King Hubbert, of the Shell Oil Company; "Atomic Energy," by Eugene P. Wigner, of Princeton University; and "Solar Energy," by Farrington Daniels, of the University of Wisconsin.

The material progress of civilization depends largely on the energy which man can make available to do his work. The energy of the sun over past ages has been abundantly stored and conveniently packaged for our use—but we are using up these resources at an alarming rate. We know that the sun's energy comes from reactions of atomic nuclei, and we have just learned how to produce atomic energy under controlled conditions from uranium which is found on earth. We are not sure that the world can be trusted with this new source of energy, but we must carry forward vigorously our research programs to determine how our resources of uranium and thorium can best be utilized for peaceful purposes.

Finally, we have the energy of the sun with us always, and we are now utilizing only a small fraction of it. Sunlight falling on the earth's surface does not give temperatures high enough to be attractive for the direct production of useful power. Our most common method of utilizing this energy is to carry out a photochemical reaction in which carbohydrates are produced which can then be burned with oxygen of the air to release this stored energy at higher temperatures. What are the facts regarding a greater utilization of the sun's energy, and what are the chances that an increasing world population, in its insatiable desire for more energy, can, in the future, obtain still more from the sun?

Most of the energy running man's machines comes from coal or oil or water power. Mr. Hubbert, associate director of exploration and production research of the Shell Oil Company, whose special interests have been in the field of geophysics, will discuss all three of these sources and will review briefly the evolution of the fossil fuels and show that many geological ages were necessary for nature to accumulate enough fuel for man to use up in a few generations. He will emphasize the point that the exploitation of fossil energy is irreversible and that the historical events associated with the exploitation of this energy are without precedent and incapable of repetition. Mr. Hubbert will give a summary of the approximate magnitudes and distributions of the various classes of fossil fuels over the surface of the earth. He will endeavor to project the time sequences into the future and will show that the rates of consumption of these fuels after passing one or several maxima must ultimately decline asymptotically to zero.

Prof. Wigner, whose special field is mathematical physics, has been associated with the development of atomic energy from its beginning and has played an important part in the successful design of the nuclear chain-reacting pile. He will discuss the possibilities for utilization of the uranium and thorium resources which are found in the earth.

Farrington Daniels, who for a number of years has been working in the field of physical chemistry and chemical kinetics and for several years has carried on research on the energy relations in photosynthesis, will point out the enormous amounts of energy which fall on every acre of the earth's surface during a year. He will emphasize the very efficient way in which nature makes use of this radiation for the production of carbohydrates and other organic material in the growth of plants. Summarizations will be given of recent views and new laboratory experiments designed to understand better the mechanism by which carbon dioxide and water are brought together by means of sunlight working through the agency of chlorophyll and of what is now known concerning the possible efficiency in the number of tons of carbohydrate which can be produced per acre per year with different kinds of plants. Dr. Daniels will also discuss some of the speculations which have been directed toward greater utilization of sunlight for the production of fuel and food, particularly in areas where the soil and water conditions are not conducive to agriculture. Other proposals that have been made for utilizing sunlight to supply the energy requirements for future civilization after the fossil fuels have been exhausted will be outlined briefly.

AAAS Summarized Proceedings and Directory

It is a pleasure to report that the *Summarized Proceedings and Directory of Members* of the Association is now nearing completion and is scheduled to be ready for distribution in August. The long delay in its appearance have been due entirely to the difficulties of getting such books printed.

The forthcoming volume is more than a report of a century of activities of the Association. It includes corresponding information about the Pacific and Southwestern Divisions of the Association. Still further, it contains important statistical data about each of its 203 affiliated and associated societies: names and addresses of their secretaries, dates of organization, objects, membership dues, total membership, divisions and branches, meetings, journals and subscription prices, prizes and medals, and libraries. Together these data present a summary of the present status of a large part of American organized science.

As a background for the activities of the Association and its affiliated and associated societies from the respective dates of their organization to the present time, the dates of the founding of the principal academies of science and universities throughout the world are recorded from the year 983 A.D. to about 1600. In order to illustrate how far the organization of scientific societies has advanced in the past 100 years, a review is presented of the attempts to establish them in this country in the decades immediately preceding the founding of the Association.

Scientific progress has been so rapid and revolutionary during the life of the Association that it is difficult now to understand and appreciate the great adventures and achievements of our predecessors a few decades ago. To assist in the orientation of readers, the historical sketch of the Association is divided into five 20-year periods, and a few of the greatest scientific discoveries in each of them are enumerated. In these reminders of the great achievements of the past

ch names as Lyell, Darwin, Kirchhoff, Mendléeff, Hertz, Maxwell, Planck, DeVries, and Bateson ppear.

The Directory part of the book, about 1,500 pages, ntains approximately 40,000 names, alphabetically ranged. The name of each member is followed by e year of his birth, his address, the university from hich he received his highest degree, his field of pecialization or chief scientific interest, his profesonal position, the year he became a member of the ssociation, the year he became a fellow, and the ection or sections of the Association with which he affiliated.

The volume closes with an unusual and valuable ection, a Geographical Index of the names and sectonal affiliations of all members of the Association s of December 31, 1947. That is, the names of all embers who are residents of the United States are rouped, first by states in alphabetical order, then y cities and towns within the respective states, also alphabetical order, and, finally, the names of embers in each city or town are arranged in alphabetical order. The names of members who are residents of foreign countries are similarly arranged alphabetically in sequence by continents, countries, cities, and individuals. The Association has members in 76 foreign countries.

It frequently happens that a librarian or scientist wishes to obtain the names of chemists, zoologists, or specialists in some other field of science who are residents of a particular city, such, for example, as Urbana, Illinois. With the new Directory before him he will turn to Illinois in the Geographical Index and then to Urbana. Probably to his surprise he will find that 77 members of the Association are residents of Urbana. To the right of each name is a letter indicating the sectional affiliation of the member, C for chemistry and F for zoology. By counting the Cs and Fs he will learn that, of the 77 members of the Association who are residents of Urbana, 33 are chemists and 29 are zoologists. If he should desire information about any chemist or zoologist in the list he would turn back to the General Directory. (F. R. MOULTON.)

NEWS and Notes

William J. Youden, for many years a member of the staff of the Boyce Thompson Institute for Plant Research, where he developed a type of experimental design known as Youden squares, has been appointed to the staff of the National Bureau of Standards. Dr. Youden, in addition to being assistant chief of the Statistical Engineering Section, will serve in an active liaison and advisory capacity to the various test boards of the Army Field Forces.

C. D. Lowry, Jr., an organic chemist and a member of the staff of the Universal Oil Products Company, has been named executive director of the Research and Development Board's Panel on Petroleum. This Panel assists in carrying out the functions of the Board in the petroleum field, coordinating service research with reference to petroleum products, their utilization, containers, and handling equipment.

Howard H. Kendler, at present an assistant professor of psychology at the University of Colorado, has been appointed associate professor at University Heights College of Arts and Pure Science, New York University, beginning with the 1948–49 academic year.

William V. Cruess, professor of food technology at the University of California College of Agriculture, has retired as head of that division and will be replaced by **E. M. Mrak,** one of his former students. Dr. Cruess will continue his research. Since 1911 he has been a member of the staff, and in 1935 he was named first chairman of the Food Products Division, later renamed Food Technology, a post he has held ever since.

G. E. MacGinitie, director of the Kerckhoff Marine Laboratory of the California Institute of Technology at Corona Del Mar, will go to the Arctic Research Laboratory at Point Barrow, Alaska, the first week in July. He will be accompanied by his wife and another assistant, David J. McNett. Prof. and Mrs. MacGinitie will return to Corona Del Mar the last of October, and Mr. McNett will return the following summer.

Daniel D. Cubicciotti, Jr., who has been research assistant at the University of California Radiation Laboratory, has been appointed research assistant professor at Illinois Institute of Technology, effective September 1.

George J. Miller, professor of geography and chairman of the Division of Social Studies, State Teachers College, Mankato, Minnesota, has been appointed visiting professor of geography at Indiana University. The editorial offices of *The Journal of Geography,* which are headed by Dr. Miller, will be moved July 1 to Indiana University.

J. J. Runner and **Allen C. Tester,** both professors of geology at the State University of Iowa, will represent that university at the 18th International Geological Congress in London, August 25–September 1. Dr. Tester will present two papers entitled "Marine Terraces of the South Pacific Area" and "Laterites in New Caledonia." He will fly to England early in August to join a pre-Congress trip covering much of England and Wales. Following the Congress Dr. Tester plans to travel in north Scotland, where he will study the geomorphology of that region. Dr. Runner,

who is planning to travel to Glasgow in late July, will make independent studies of lava rock outcrops in the region. He is tracing some of the outlines of an immense lava flow which is thought to have once covered an area from Scotland and the Hebrides to Iceland.

Ralph Mozingo, head of the Hydrogenation Laboratory of the Organic and Biochemical Research Department, Merck & Co., Inc., will join the staff of the University of Minnesota as associate professor of organic chemistry for 1948–49, serving in place of **Richard T. Arnold,** who will be on sabbatical leave. In announcing the appointment, Prof. Lee I. Smith, of the University of Minnesota, pointed out that, while many industries have aided universities through grants and scholarships, the loan of Dr. Mozingo by his firm for this extended period of time constitutes a unique example of cooperation between industry and an educational institution.

Theodore W. Torrey has been appointed chairman of the Department of Zoology at Indiana University. Dr. Torrey replaces **Fernandus Payne,** who is retiring from departmental administrative duties.

Frank F. Grout, professor of geology and mineralogy, University of Minnesota, will retire July 1. As a retirement gift, his students, colleagues, and friends have presented him with a cash purse to defray his expenses to the forthcoming International Geological Congress.

Grants and Awards

New York University has just received from the Office of Naval Research a grant of $15,000 for the support of research on the fundamental mechanism of muscular contraction. This research will be carried on in the Department of Biology, Washington Square College of Arts and Sciences, under the direction of Alexander Sandow.

Sidney W. Benson, professor of chemistry, University of Southern California, has just received an award in the form of a fellowship from the Research Corporation for work on the surface areas and structures of proteins. The fellowship will be held during 1948–49 by David A. Ellis, graduate student in physical chemistry who is working for his Ph.D.

Wendell M. Latimer, dean of the School of Chemistry, University of California, has been awarded a distinguished service citation by the Alumni Association of the University of Kansas, from which he was graduated in 1915.

The Society for American Archaeology, at its annual dinner held in Milwaukee, Wisconsin, on May 14, presented the Viking Fund Medal and Award to John Otis Brew for his outstanding contribution on the archaeology of Alkali Ridge, Utah. Dr. Brew is the new director of the Peabody Museum, Harvard University.

John Collier, professor of sociology at the College of the City of New York and president of the Institute of Ethnic Affairs, Inc., has just received a $1,000 Anisfield-Wolf Award for his book, *The Indians of the Americas,* published by W. W. Norton and Company in 1947. This book and Worth Tuttle Hedden's *The other room,* which also received a prize, were adjudged the best works on race relations published during the preceding year.

The Worcester Foundation for Experimental Biology has had available for its use during the fiscal year, just closed, approximately $207,000 in gifts and grants. Of this sum $19,162 has been contributed by friends of the Foundation in the form of membership fees.

The Foundation has been the recipient during the year of approximately $160,500 as grants for researches in mental disease, problems of human aging, cancer, animal reproduction, use of radioisotopes, and organic and biological chemistry. These grants have been made by the U. S. Public Health Service, the Office of Naval Research, the Williams-Waterman Fund of the Research Corporation, the Foundation of Applied Research, the National Research Council, the National Academy of Sciences, the Schering Corporation, the G. D. Searle Company, Ayerst, McKenna and Harrison, Ltd., the American Cancer Society, the Donner Foundation, the L. Farber Company, the American Academy of Arts and Sciences, and the American Medical Association.

At the Trustees' meeting on June 5, Thomas B. Slick was elected a member of the Board, and Harlow Shapley and Roy G. Hoskins were re-elected president and secretary of the Board, respectively. Mr. Slick is president of the Slick Oil Company and technical adviser of three institutions founded under his guidance at San Antonio, Texas—the Foundation of Applied Research, the Southwest Research Institute, and the Institute of Inventive Research.

At a reception at the laboratories on June 5 H. J. Muller, Trustee of the Foundation and 1946 Nobel Laureate in Physiology and Medicine, gave an address entitled "Effects of Radiation on the Hereditary Material."

The Foundation is operated under the co-direction of Hudson Hoagland and Gregory Pincus.

Colleges and Universities

The University of Illinois College of Medicine is to have the world's first installation of a betatron for cancer treatment and research. Although the cancer-fighting possibilities of the betatron were pointed out early by its inventor, Donald W. Kerst, of the University's Physics Department, such work was delayed during the war. Research with the 20,000,000-volt instrument, which will be delivered in about 5 months, will be in charge of Roger A. Harvey, head of the College's Department of Radiology. X-rays now in use for treating deep cancers have energies ranging from 200,000 to 2,000,000 volts. Prof. Kerst's first instrument in 1940 produced 3,500,000-volt X-rays. At present he is building a 300,000,000-volt betatron for physics research. Prof. Kerst has found that the 20,000,000-volt X-rays have their greatest effect approximately 1½" inside the surface of the body and that after passing through 8" (approximate thickness of the human body) their energy is only about half that at the maximum point. This means that maximum concentration of the rays will be on the deep internal organs. Other advantages of the betatron include precise control of the energy

produced and a narrow, sharply-defined ray beam. Henry Quastler, of the University's physics staff, who has been testing the betatron, is now working on a diaphragm for the beam to control the small amount of scattering of X-rays and electrons—one of the problems which requires solution before the betatron can be used for the treatment of patients. By a change of vacuum tubes, a beam of electrons may be produced by this industrial-type machine, but considerable intensive study by medical scientists will be required before these may be used safely on human subjects.

The Department of Physics, Tufts College, Medford, Massachusetts, has recently announced the appointment of Charles R. Mingins as director and Carl A. Stevens as assistant director of the Research Laboratory of Piezoelectricity. This laboratory is organized as a part of the Department of Physics, of which Stanley S. Ballard is chairman, to carry on undergraduate and graduate instruction and thesis work as well as staff research in piezoelectricity, physical electronics, and related fields. The director and assistant director also serve as associate professor and assistant professor of physics, respectively, on the instructional staff. The laboratory is currently conducting quartz crystal investigations under a contract with the U. S. Signal Corps.

Summer Programs

The U. S. Public Health Service Communicable Disease Center, Atlanta, Georgia, has announced its first four-week refresher course, "Laboratory Diagnosis of Mycotic Diseases," to be given August 30–September 24. The course will be concerned with the identification of common saprophytes and the identification and culture of the dermatophytes, subcutaneous fungi, and systemic fungi. Stress will be placed on laboratory procedures useful for establishing a diagnosis of mycotic infection. The training is open to all grades of employed laboratory personnel. Although first consideration will be given to applicants from laboratories of state and local public health departments, applicants from hospitals and private laboratories will be considered when vacancies occur. While there is no laboratory or tuition fee, travel and living expenses must be borne by the applicant or his employer.

Applications should be sent as soon as possible to Seward E. Miller, Chief, Laboratory Division, Communicable Disease Center, 291 Peachtree Street, Atlanta, Georgia. Notification of acceptance will be made sufficiently in advance to allow the students to obtain living accommodations.

A series of 7 lectures entitled "The Role of Science Today" will be offered by Roosevelt College, Chicago, in a special summer institute to be held July 12 through August 2. Morris Goran, chairman of the Physical Science Courses and associate professor of chemistry at Roosevelt, will direct the sessions. The series will include a survey of science from Galileo to nuclear energy and radar, an analysis of the scientific attitude, the scientific method, and the meaning of science to the individual and the community. Further information may be obtained from Morris Goran, Chairman of Physical Science Courses, 430 South Michigan Avenue, Chicago 5, Illinois.

NRC News

A preliminary report on the Survey of University Patent Policies has just been released by the National Research Council. This report on the survey which the Council has been conducting for the past two years is presented for the information and guidance of research scientists, university administrators, patent attorneys, industrialists, and others concerned with the conduct, administration, and support of scientific research and the handling of patentable discoveries and inventions growing out of research on the university campus.

For more than 30 years the Council has been interested in the patent problem. In 1917 the U. S. Commissioner of Patents, with the approval of the Secretary of the Interior, requested the Council to appoint a committee to investigate the Patent Office and the patent system, with a view to increasing their effectiveness, and to consider what might be done to make the Patent Office more of a national institution and more vitally useful to the industrial life of the country. The report of the Patent Committee, appointed by the Council in compliance with that request, was issued in 1919 as the first publication in the Council's Reprint and Circular Series.

The Council's present Committee on Patent Policy, under whose sponsorship this survey of university patent policies has been conducted, was created in 1933. Through the years this Committee has given continuing consideration to the various aspects of the patent problem and has held several conferences on the general subject and on specific patent questions.

The present survey has been conducted under the direction of Archie M. Palmer, who has been a member of the Council's Committee on Patent Policy since its inception. With thoroughness and acuity, resulting from deep personal interest and extended experience with the problem as university administrator and research worker, he has analyzed the prevailing practices of the universities and has prepared this preliminary report on his findings.

The report is organized in a series of analytical chapters on personal research, institutionally supported research, sponsored research, medical patents, patent management procedures, and patent revenue, with a general background discussion of patents and university research, an over-all analysis of the present situation, and an appendix containing verbatim statements of 37 definitive university patent policies.

The report is available at $1.50 per copy from the Patent Policy Survey, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.; checks should be made payable to National Academy of Sciences.

The Committee on Patent Policy is composed of George B. Pegram (chairman), Bruce K. Brown, Conway P. Coe, Gano Dunn, Edward S. Mason, Archie M. Palmer, Lewis H. Weed, and Detlev W. Bronk, chairman of the Council, *ex officio*.

Through its Committee on Patent Policy and the director of the survey, the Council gratefully acknowledges its indebtedness to the college and

university officials, scientists, and others who liberally contributed information and data concerning existing policies and practices, and to the Research Corporation, which made the survey possible through a generous grant to the Council without placing any restrictions on the conduct of the survey or assuming any responsibility for the findings.

Deaths

Jan Blaton, 42, professor of physics at the Jagellonian University, Krakow, Poland, was killed May 17 in a fall while on a holiday in the Polish Tatra Mountains. Dr. Blaton was the leading younger theoretical physicist in Poland.

Frances Grace Smith, 76, emeritus professor of botany at Smith College, died May 25 in Northampton, Massachusetts, following a heart attack.

Otto Marburg, 74, clinical professor of neurology at Columbia University and international authority on nervous diseases, died June 13 in New York City.

The British Commonwealth of Nations Scientific Liaison Offices (London) have been opened on the third floor of Africa House, Kingsway, W.C.2, in order to bring together several of the Commonwealth countries' scientific liaison offices and also those about to be organized. Each of the offices will continue to operate with complete independence of action, but the convenience of occupying adjacent premises will facilitate closer cooperation between them on matters of common interest. The offices taking part in the scheme are the Scientific Liaison Offices of Australia, Canada, Central African Council, India, New Zealand, South Africa, and the United Kingdom. Pakistan and the Commonwealth Agricultural Bureaux will be represented, and the Overseas Liaison Division of the U. K. Department of Scientific and Industrial Research will be located there.

The Loyal Order of Moose, with the cooperation of the University of Chicago, is sponsoring the Second International Symposium on Feelings and Emotions on October 28–30. The Mooseheart Symposium, under the general chairmanship of Martin L. Reymert, director of the Mooseheart Laboratory for Child Research, is held on the occasion of the 20th anniversary of the publication, "The Wittenberg Symposium on Feelings and Emotions." Anton J. Carlson, professor emeritus of physiology at the University of Chicago, is honorary chairman. Among the contributors will be: John E. Anderson, University of Minnesota; Magda Arnold, Wellesley College; Samuel J. Beck, Michael Reese Hospital, Chicago; B. P. Bapkin, McGill University; Dorwin Cartwright, Massachusetts Institute of Technology; Chester Darrow, Illinois Institute of Juvenile Research; John Elmgren, University of Gothenburg, Sweden; Franklin Fearing, University of California; C. B. Frisby, National Institute of Industrial Psychology, London; Arnold Gesell, Yale University; R. L. Jenkins, University of Illinois; Harold Jones, University of California; David Katz, University of Stockholm; Herbert Langfeld, Princeton University; George Lawton, New York City; H. S. Liddell, Cornell University; Rensis Likert, University of Michigan; Donald B. Lindsley, Northwestern University; Jules Masserman, Northwestern University; Margaret Mead, American Museum of Natural History; Albert E. Michotte, University of Louvain; James G. Miller, University of Chicago; Gardner Murphy, The City College of New York; Henry A. Murray, Harvard University; Ørnulv Ødegaard, University of Oslo; Henri Pieron, University of Sorbonne; Curt Richter, Johns Hopkins Hospital, Baltimore; Anne Roe, New York City; Carl R. Rogers, University of Chicago; Saul Rosenzweig, Western Pennsylvania Psychiatric Institute and Clinic; David Shakow, Illinois Neuropsychiatric Institute and University of Chicago; Nathan W. Shock, U. S. Public Health Service; William Stephenson (formerly of Oxford University), University of Chicago; Roger J. Williams, University of Texas; and Harold G. Wolff, New York Hospital. The full list of contributors will include 40–45 scientists in various disciplines from different parts of the world. The sessions on October 28 will be held at Mooseheart, Illinois, and those on October 29 and 30 at the University of Chicago. In planning the program, Dr. Reymert has been assisted by Anton J. Carlson and James G. Miller, of the University of Chicago, Herbert Langfeld, of Princeton University, and others. All sessions of the conference will be open without tickets to those interested.

There will be Open House for all who wish to visit Mooseheart, the City of Childhood, on Wednesday, October 27, and Sunday, October 31.

Some of the speakers at the Symposium will participate in the University of Chicago Round Table national network radio broadcast on Sunday, October 31.

Information concerning hotel accommodations and other matters may be obtained by writing to Dr. Reymert. A Housing Committee will soon be established in Chicago. Participants will be given gratis transportation between Chicago and Mooseheart through the courtesy of the Moose Fraternity. Further details concerning the Symposium will be announced at a later date.

Make Plans for—

Applied Mathematics Symposium of American Mathematical Society, July 29–31, Massachusetts Institute of Technology, Cambridge.

International Congress on Mental Health, August 11–21, London, England.

International Society of Hematology, biannual meeting, August 23–26, Hotel Statler, Buffalo, New York.

American Institute of Electrical Engineers, August 24–27, Spokane, Washington.

International Geological Congress, 18th Session, August 25–September 1, London, England.

American Chemical Society, August 30–September 4, Washington, D. C.

7th International Congress of Applied Mechanics, September 5–11, Imperial College of Science and Technology, South Kensington, London, England.

TECHNICAL PAPERS

Confirmatory Analysis of the "Lost" Italian Varnish

JOSEPH MICHELMAN[1]

5050 Oberlin Boulevard, Cincinnati, Ohio

The old Italian violin makers such as Stradivari, the Guarneris, and the Amatis applied a varnish on their instruments that has not been equaled for beauty, transparency, and permanence. Unfortunately, they did not leave to posterity any record concerning its composition.

In a previous paper (*2*) confirmatory evidence of the rediscovery of the "lost" Italian varnish was presented from the results of spectrographic and microchemical analyses. However, all of the 10 specimens available for analysis at that time were brown in color. Subsequently, a good specimen of a brown-red varnish from a Francesco Ruggieri cello (1691) was obtained through the courtesy of Otto Lang, of St. Louis County, Missouri. As the red-colored varnishes of the old Italian violin makers were highly characteristic and as it has not been possible heretofore to produce red varnishes of similar transparency and permanence, spectrographic and microchemical analyses of this specimen should be informative.

Microchemical analysis. The theory was recently advanced by the writer (*1*) that the red color of the old Italian varnish was due to the presence of madder, which was the most important dyestuff known in those eras. A test for this coloring agent was developed, using varnishes containing madder (*1*). The presence of madder in the varnish from the Ruggieri cello was indicated by this test.

The behavior of this varnish upon solution in dilute alkali followed by precipitation with dilute acetic acid suggested the presence of resinous and/or fatty acids.

Spectrographic analysis. The Ruggieri specimen displayed the presence of a colored outer varnish and a yellow subvarnish, a combination frequently employed by the old Italian violin makers. As it was possible to separate the strata cleanly, spectrographic analyses were made of each layer. Shaw reported the following results for the two analyses: brown-red outer varnish—large amount of Ca, small amount of Si, Cu, Al, K and Mg, and trace amount of Na, Mn, and Fe; yellow subvarnish—large amount of Ca, small amount of Si, Cu, Al, K, Mg, Na, Mn, and Fe, and trace amount of Pb, Sn, and Ni.

The presence of calcium alone in relatively large amounts and of madder in a brown-red old Italian varnish is highly significant. It had been previously shown (*1*) that varnish films of madder-calcium rosinate are brown-red in color. Both analysis and synthesis have supplied some confirmatory evidence of the rediscovery of the "lost" Italian varnish.

The similarity of the analysis of the brown-red outer varnish to that of the subvarnish is also noteworthy. This would indicate that the subvarnish was converted to the color varnish by the addition of the coloring agents in madder, which is easily accomplished.

The other elements revealed by the spectrographic analyses may be due to the use of wood ashes, which the ancients could have employed to "harden" rosin and make it more suitable for varnish-making.

It was at first reported (*1*) that, if raw linseed oil is used with madder-calcium rosinate, the color is destroyed. However, by pretreating the oil, applying the varnish in thin films, and exposing these at once to light, the color becomes permanent. A brown-red varnish composed of alizarine-calcium rosinate and linseed oil, with turpentine as the solvent, has been prepared that possesses the desired depth of color, transparency, and permanence in its dried and aged films.

[1] The cooperation of Otto Lang in supplying the specimen of varnish and of Everett J. Shaw in making the spectrographic analyses is gratefully acknowledged.

References

1. MICHELMAN, JOSEPH. *Violin varnish.* Cincinnati, O.: Author, 1946. Pp. 78, 84, 171.
2. MICHELMAN, JOSEPH. *Amer. Paint J.*, February 16, 1948, 62.

An Experimental and Theoretical Approach to the Mechanism of Cocaine Action[1]

A. M. SHANES

Department of Physiology and Biophysics, Georgetown University School of Medicine, Washington, D. C.

The mathematical theories of excitation developed by Hill (*5*) and others regard the rate of development of the excitatory process under the stimulating electrode to be of great importance. A certain group of blocking agents, including cocaine, act without appreciably altering the "resting" state of polarization of nerve (*1, 2*), and these appear to reduce permeability (cf. *6*). In view of these considerations an hypothesis has been set up with the postulate that the rate of transport of potassium from within to outside the fibers (e.g. under the cathode on "make") is a controlling factor in stimulation. On this basis, cocaine and related compounds would be expected to act by reducing membrane permeability to potassium. The following is a summary of some of the experiments which have been designed to test for such permeability

[1] A preliminary account of these results was presented at the 32nd Annual Meeting of the Federation of American Societies for Experimental Biology. This work was aided by a grant from the American Philosophical Society.

changes in the sciatic nerve and sartorius muscle of *Rana pipiens*.

The permeability of muscle to anions as well as K will cause this tissue to swell in solutions in which Na is

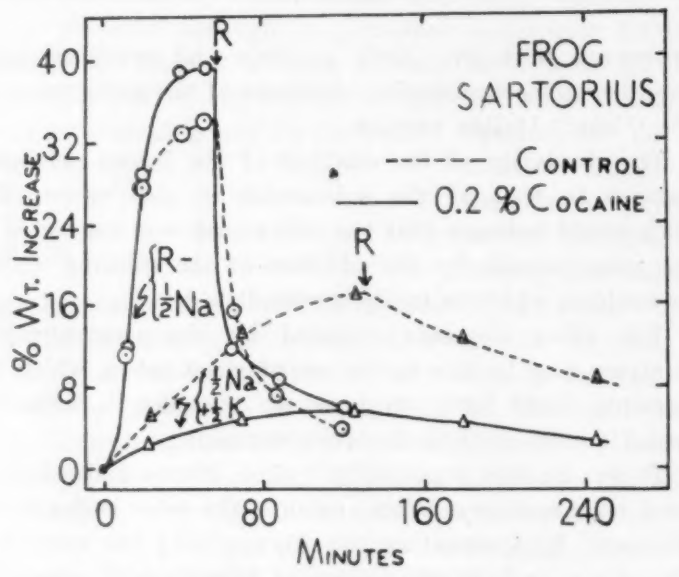


FIG. 1. The increase of weight, relative to that in Ringer after 2 hrs soaking with or without cocaine present, measured from the moment of change of the Na content of the medium. R indicates a return to normal Na levels. The lower curves are the averages of 6 paired muscles; the upper, of 3 paired preparations. Each pair behaved as indicated.

replaced by K (*3*); the rate of weight increase which occurs in such K-replacement media has been successfully employed in measuring relative permeabilities (*4*). Fig. 1 illustrates that when half of the Na in Ringer's

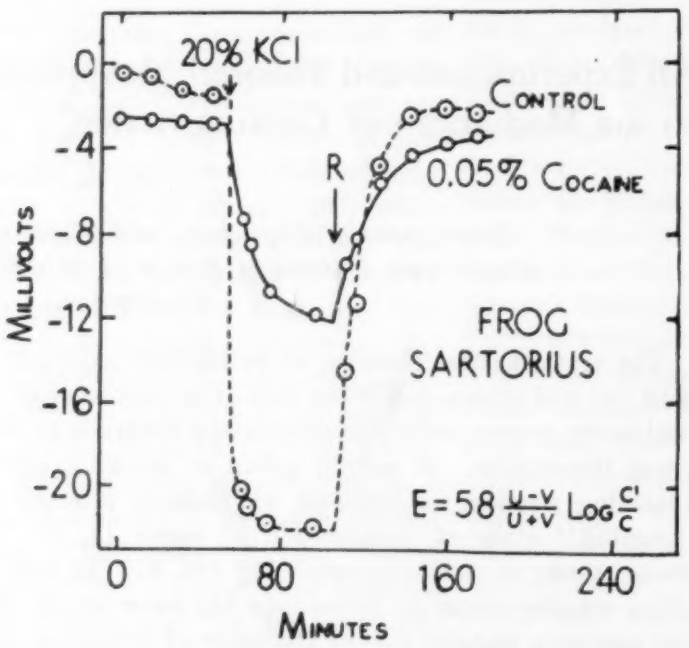


FIG. 2. The potential of the tibial end of paired sartorii, after a 2-hr preliminary soaking in Ringer with or without cocaine, relative to the central region used as a reference. The potassium solution, applied to the tibial region, was of the "replacement" variety. Similar results were obtained with KCl present in excess.

solution is replaced with K, the weight increase which normally occurs is considerably reduced by 0.2% cocaine —a concentration which does not abolish the response to electrical stimulation. Water movement itself is not affected appreciably, as demonstrated by the swelling in a ½ × Ringer's solution. Under these conditions, therefore, cocaine reduces KCl penetrability.

In Fig. 1 it is apparent that KCl diffusion is still incomplete after 2 hrs; nevertheless, the maximum lowering of potential, produced at the tibial end by application of Ringer's solution with one-fifth of its Na replaced with K, is attained in 10–20 min. (Fig. 2). Obviously, this cannot be considered a Donnan equilibrium potential drop, inasmuch as the system is far from equilibrium. Rather, the conditions justify the application of the equation for a diffusion potential, such as that given in Fig. 2, where E is the change in potential; U, the mobility of potassium; V, the mobility of chloride; C′, the KCl concentration applied; and C, that previously existing in the Ringer.

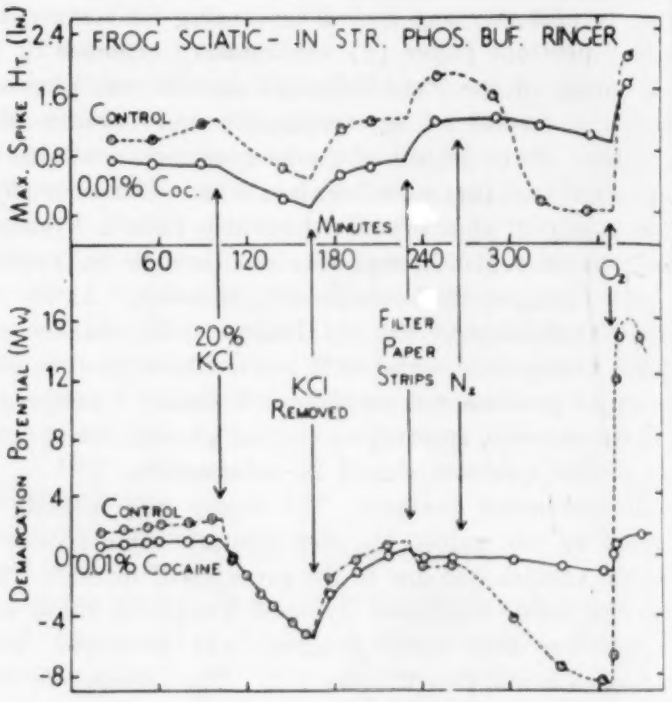


FIG. 3. The effect of localized anoxia and application of KCl (replacing an osmotically equivalent amount of NaCl from Ringer) on (A) the maximum spike height, given in inches of deflection of the cathode-ray beam, and (B) the demarcation potential relative to another region of the nerve kept in Ringer and oxygen for reference. As usual, the nerves are from the same animal and were soaked for 2 hrs in Ringer, with or without cocaine present, prior to the experimental run in the moist chamber. "Filter paper strips" indicates the elevation of the nerves on these as electrical conductors to facilitate gas exchange. In this experiment calcium was lacking from the medium to enhance the anoxic decline of potential.

Short-circuiting by the extracellular space and the swelling of fibers limit the significance of the absolute potential changes obtained. However, from the diffusion equation it may be predicted that if the mobility of K relative to Cl is reduced, the effectiveness of K in lowering the potential will be correspondingly affected. The action of cocaine shown in Fig. 2 is typical of all 6 experiments which were performed and therefore supports the view that K penetrability is reduced by the anesthetic.

Frog nerve differs from muscle in its negligible permeability to anions, as indicated by potential (*7*) and

osmotic (*10*) experiments. In terms of the diffusion equation discussed above, when V is very small, a change in U will have no effect on E until U approaches V. This provides an explanation for the failure of cocaine up to 0.2% to produce a consistent reduction in the effectiveness of applied KCl in lowering the potential (Fig. 3).

For frog nerve evidence has been presented that the rise of resting potential in 5% CO_2–O_2 and its decline during anoxia are due to the uptake and release of K by the fibers, the associated changes in the K concentration of the extracellular spaces being the immediate major cause of the potential changes under these conditions (*8, 9*). A reduced permeability to K therefore would be indicated by a decrease in the magnitude of the potential changes in both cases. This has been observed under a variety of experimental conditions and with the lowest cocaine concentration employed (viz., 0.0005%).[2] Fig. 3, typical of a number of such experiments, is particularly instructive, inasmuch as it demonstrates not only that cocaine delays the decline of potential of a section of nerve rendered anoxic, but that the prevention of this depolarization is a sufficient condition for the maintenance of functional activity as judged from the maximum attainable spike heights observed at the stimulating electrode.

An examination of substances which resemble cocaine by virtue of a "stabilizing" action, e.g. procaine (*1, 11*), sulfanilamide and thiophene-2-sulfonamide (*8, 9*), recalls that Wilbrandt (*12*) employed similar basic compounds to reduce and reverse the negative charge normally present on collodion membranes. Such a mechanism of action appears attractive, inasmuch as chemical potentials obtained with nerve and muscle indicate that these and probably most animal cells have negatively charged surfaces (*6*). Some unpublished observations indicating that *p*-aminobenzoic acid enhances the ability of sulfanilamide to counteract the anoxic decline of the resting potential in frog nerve are readily explained on this basis.

These experiments therefore support the view that cocaine, at properly controlled concentrations, reduces the permeability of frog nerve and muscle to potassium. On this basis another tool is at hand for the analysis of the role of ionic movement in highly transitory phenomena. Thus, observations which have already been made of its action on the time constant of the excitatory process (Hill's "k," which is related to chronaxie) and on the afterpotentials in nerve suggest ionic transport under these conditions. These results and others, which cannot be included in this brief report, will be presented in greater detail subsequently.

References

1. Bennett, A. L., and Chinburg, K. G. *J. Pharm. exp. Therap.*, 1946, **88**, 72.
2. Bishop, G. H. *J. cell. comp. Physiol.*, 1932, **1**, 177.
3. Boyle, P. J., and Conway, E. J. *J. Physiol.*, 1941, **100**, 1.
4. Conway, E. J., and Moore, P. T. *Nature, Lond.*, 1945, **156**, 170.
5. Hill, A. V. *Proc. roy. Soc. Lond.*, 1936, **B119**, 305.
6. Hober, R. *Physical chemistry of cells and tissues.* Philadelphia: Blakiston, 1945.
7. Netter, H. *Pflüg. Arch. ges. Physiol.*, 1928, **218**, 310.
8. Shanes, A. M. *Biol. Bull.*, 1946, **19**, 211.
9. Shanes, A. M. *Yb. Amer. phil. Soc.*, 1946, 162.
10. Shanes, A. M. *Fed. Proc.*, 1948, **7**, 111.
11. Toman, J. E. P., Woodbury, J. W., and Woodbury, L. A. *J. Neurophysiol.*, 1947, **10**, 429.
12. Wilbrandt, W. *J. gen. Physiol.*, 1935, **18**, 933.

[2] In a recently published monograph (*Stud. Rockefeller Inst.*, 1947, **131**, 117), Lorente de Nó concludes that the reduced anoxic decline of potential in cocaine is due to a lowered respiratory rate, although Sherif (*J. Pharm. exp. Therap.*, 1930, **38**, 11) has shown that these concentrations of cocaine have no effect on respiration.

Loss of Radioactivity From Barium Carbonate Samples[1]

Peter E. Yankwich

Department of Chemistry and *Radiation Laboratory, University of California, Berkeley*

Several investigators have reported observations which lead them to conclude that barium carbonate samples containing C^{14} can lose rapidly rather significant fractions of their activity by exchange with atmospheric carbon dioxide through the agency of moisture. In many experiments it is desirable to store counting samples for possible checking after weeks or months, and any rapid loss of activity by exchange or any other process would make such a practice hazardous in so far as experimental accuracy is involved; other consequences of rapid exchange loss are legion and need not be detailed here.

Two current papers report the results of purposeful investigations of this exchange phenomenon. One of these (*2*) deals only with exchange loss when solutions of sodium bicarbonate (pH 8.8) are evaporated to dryness in a variety of atmospheres. It was observed that even the small concentration of carbon dioxide in laboratory air caused losses as high as 60% in a single evaporation.

Most C^{14} radioactivity determinations of solid samples are made on barium carbonate, and it is to be expected that this solid can lose activity by exchange with carbon dioxide, through carbonic acid and its ions, though the rate of this exchange should be inappreciable in the absence of water. Though several estimates have been made as to the rate of loss of activity from precipitates of barium carbonate, only one paper has been published which contains the results of experimentation designed to explore the problem (*1*).

In that study, thick deposits of barium carbonate were prepared by filtering a slurry of freshly precipitated solid through a retentive filter paper; the samples were dried by drawing air through the filter after washing the mass with acetone and ether. All samples used in the investigation were of "infinite thickness" with regard to the C^{14} beta radiations. Several samples thus prepared were subjected to atmospheres of (1) moist carbon dioxide,

[1] This paper is based on work performed under contract No. W-7405-Eng-48 with the Atomic Energy Commission in connection with the Radiation Laboratory, University of California, Berkeley.

(2) moist carbon dioxide-free nitrogen, and (3) dry carbon dioxide. The experiments were carried out in a desiccator, the bottom of which was covered with a layer of acidified water during the "moist" experiments. Exchange was observed only in the first case; after 65 hrs, 37.4% of the activity had disappeared from the solid and was recoverable from the gas phase.

Somewhat different results have been obtained in these laboratories with samples prepared by evaporation-settling technique (*3*). Samples are prepared by the evaporation of 95% alcohol from an alcohol-barium carbonate slurry; after the evaporation is complete, the samples are *dried for a few seconds at 160° C.* (The barium carbonate used in these experiments was *dried at 115°* after precipitation from an ammonium nitrate-sodium hydroxide solution; washing on the filter was carried out with distilled water only.)

(I) Four different types of experiment were performed, the first of which was a repeat of the work just described. Two plates (deposits of solid on aluminum), 3.7 and 5.6 mg/cm² thick, were stored in a sealed desiccator, the bottom of which was covered with distilled water; the gas space was swept with a moderate stream of tank carbon dioxide for 15 min before the vessel was sealed. After 172 hrs the plates were removed and counted; the activity loss in both cases was $0.9 \pm 1.0\%$. Concentrated hydrochloric acid was added to the water layer in an amount necessary to produce an approximately 3N solution; the samples were put back into the vessel, which was swept again with carbon dioxide and sealed. The samples were removed after 150 hrs and their radioactivities determined; the lighter sample lost an additional $1.2 \pm 1.0\%$ of its original activity, while the heavier plate apparently gained $0.2 \pm 1.0\%$. The atmosphere during the second part of this experiment was sufficiently acid to etch the exposed portions of the aluminum sample mounts.

These experiments were repeated with samples, prepared by filtration technique (*1*), which were about 8 mg/cm² thick. In carbon dioxide moistened by distilled water one sample lost $33.0 \pm 1.1\%$ of its activity in 56 hrs. A similar sample prepared from the same batch of barium carbonate lost 36% of its activity when stored in CO_2 moistened by acidified water for 56 hrs. During 56-hr "acid" storage, similar samples prepared from batches of barium carbonate precipitated under various other conditions lost amounts of their original activities which varied from 5 to 40%, all losses occurring without important changes in weight.

(II) An experiment was performed to give information on the exchange rate when the heat-dried solid was in contact with two solvent media. Two plates, both 4.65 mg/cm² thick, were carefully freed of loose particles and placed in shallow dishes. One was covered with 95% ethanol saturated with carbon dioxide, and the other was covered with distilled water, also saturated with carbon dioxide (this gas is about three times as soluble in ethanol as in water). After 28 hrs the samples were carefully removed from the dishes and dried in air at 100°. Radioactivity determinations showed that both samples lost only $0.3 \pm 1.0\%$ of their activity in this time.

(III) In a third test, small portions of carbon dioxide-saturated ethanol and water, and carbon dioxide-free ethanol and water, were evaporated repeatedly from heat-dried barium carbonate plates of various thicknesses.

TABLE 1

ACTIVITY LOSS FROM $BaCO_3$ PLATES—REPEATED LIQUID EVAPORATION

Liquid	Typical Result			Dependence on sample thickness
	Thickness (mg/cm²)	Liquid volume (ml)	Activity loss (%)	
95% ethanol	4.65	11.0	0.0 ± 0.6	None observed
Dist. H_2O	0.42	15.0	0.8 ± 0.1/ml of liquid	Loss/ml decreases with increasing thickness
95% ethanol + CO_2	4.82	21.0	0.2 ± 0.5	None observed
Dist. H_2O + CO_2	0.41	9.1	0.8 ± 0.1/ml of liquid	Loss/ml decreases with increasing thickness

The plate was freed of loose particles and wet with 0.25 ml of the solvent or solution to be investigated, then dried in air at 100°. The plate was then cooled, another portion of liquid added, and the cycle repeated; at suitable intervals the sample radioactivities were measured. The results are summarized in Table 1. The small difference in the rate of loss between the two aqueous media probably is due to very rapid loss of dissolved carbon dioxide from the evaporating solution of carbon dioxide in water; the rate of loss with this solution probably would be considerably higher if the evaporation were carried out under a constant pressure of carbon dioxide.

TABLE 2

LONG-TERM LOSS OF ACTIVITY FROM $BaCO_3$ SAMPLES

Conditions of storage	Plate thicknesses (mg/cm²)	Mean % loss (9 wks)*
Uranium glass	.....	1.2 ± 1.2
$BaCO_3$—shellac bound	.....	1.0 ± 1.2
Covered Petri dishes	1.65,2.20	2.9 ± 2.0
Office-type room	0.53, 3.06	2.6 ± 1.2
Outdoors (protected only from rain)	1.07, 2.90	15.2 ± 4.2
Stream of wet outdoor air	0.63, 3.29	3.6 ± 1.3
Drying oven at 130° (air)	1.35, 2.14	3.6 ± 1.4
Stream of wet CO_2	1.75, 2.87	8.0 ± 1.4
Organic synthesis laboratory, low CO_2, relatively acid air	1.03, 2.77	6.0 ± 1.3
Combustion room, high CO_2, relatively acid air	0.66, 1.88	12.1 ± 1.6
Sample storage book; somewhat better sealed than Petri dishes	1.25, 2.86, 3.10	1.7 ± 1.3 (20 wks)

* Error includes counting error and sensitivity loss.

(IV) In one of the papers cited (*1*) a loss of 2.7% in 6 days is reported for a sample stored in a covered Petri dish. A fourth set of experiments has been performed to shed more light on this long-term exchange loss. Pairs of heat-dried barium carbonate plates of different thicknesses were stored over a period of 9 weeks in different controlled and uncontrollable atmospheres. At intervals of 10 to 14 days the plates were collected and their radioactive strengths determined; at the end of the test all samples were reweighed, but no significant weight changes were observed. The sensitivity of the counter was checked with standards of uranium glass and of shellac-bound barium carbonate. The data obtained are collected in Table 2.

It is apparent from these data that some barium carbonate samples, at least those which are heat dried, can be stored for long periods without serious loss of activity. Exchange may not be a trivial matter with samples prepared by other methods, because of particle size distribution, particle surface condition, etc.; each circumstance at least requires observation of active samples for long periods.

References

1. Armstrong, W. D., and Schubert, J. *Science*, 1947, **106**, 403.
2. Leslie, W. B. Experimental use of C^{14}. Atomic Energy Commission, MDDC 674.
3. Yankwich, P. E., Rollefson, G. K., and Norris, T. H. *J. Chem. Phys.*, 1946, **14**, 131; Dauben, W G., Reid, J. C,. and Yankwich, P. E. *Anal. Chem.*, 1947, **19**, 828. See also: Hendricks, R. H., Bryner, L. C., Thomas, M D., and Ivie, O. *J. phys. Chem.*, 1943, **47**, 469.

IN THE LABORATORY

A Piston Recorder for Small Volume Changes

Foster N. Martin, Jr.

Department of Pharmacology, Tulane University of Louisiana School of Medicine

The apparatus here described was designed for use in recording small volume changes, associated with pressure changes, such as occur in the eye of a cat following administration of vasoconstrictor drugs.

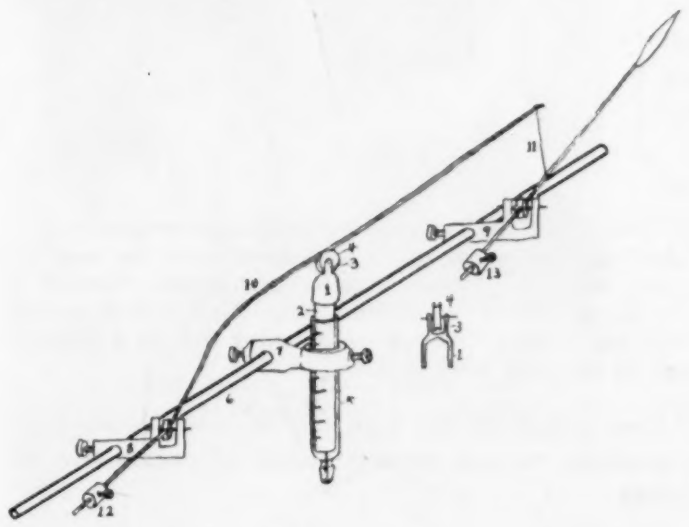


Fig. 1

The basic part of the apparatus (Fig. 1) is a piston made from a portion of a tuberculin syringe. A brass cap (1) was drilled to fit the cut-off plunger (2) of the syringe and then turned on the lathe until very thin. A stem about one-third the diameter of the cap and 5 mm long was left projecting at the top. The projecting stem was sawed and filed into a U-shaped fork (3) and fitted with a small, grooved pulley (4) which was held in place by a small pin of stainless steel wire. This cap was placed on the plunger (2), which was then inserted in the syringe barrel (5). The latter was cut shorter than the plunger to prevent the cap from striking it. This piston assembly was fixed to a small brass rod (6) by means of a clamp (7) made of brass and drilled vertically to fit the syringe barrel and horizontally to fit the rod.

Lever supports (8, 9) were made to fit the same rod, supplied with levers of aluminum wire, and fixed one on each side of the piston clamp. One aluminum wire lever (10) was bent to fit and placed in the groove of the pulley (4) on the piston cap. A thread (11) was used to attach the first lever to the second to magnify the movements.

Adjustment of the magnification of the movement could then be made by altering the distance between the first lever clamp (8) and the piston clamp (7) and also by varying the position of the thread (11) connecting the two levers. The weight of the levers may be nullified by using small cylindrical brass counterweights (12, 13) fastened by set screws on the short ends of the levers.

An hydraulic system is necessary for smooth operation of the piston assembly. Water is not satisfactory, since the small amount lost by evaporation from the piston will show as a gradual fall in the base line of the record. Mineral oil is perhaps best for filling the piston. As used for recording intraocular pressure changes, a small mercury manometer made of fine-bore glass tubing was interposed between the piston and the eye, oil being used on the piston side of the manometer and aqueous solutions on the other.

With a piston made of about one-third of a tuberculin syringe volume, changes up to about 0.2 cc may be recorded, giving an excursion on the record of 10–20 cm or

less, according to the adjustment of the levers. By using other sizes of syringes in a similar way other orders of volume changes may be recorded.

Radiation From a Flask Containing Various Amounts of Radioactive Phosphorus[1]

RUSSELL F. COWING and EGILDA DEAMICIS[2]
New England Deaconess Hospital, Boston

The handling of radioactive phosphorus becomes a radiation hazard if not properly executed.

One must consider beta particles from radioactive phosphorus as a potential hazard. These beta particles produce ionization directly and thus directly injure tissues. The most energetic of these particles penetrate tissue to a depth of 8 mm (*2, 5*), and during this passage each expends 2.7×10^{-6} ergs of energy (*3*). If one were to receive as whole-body radiation the permissible daily dose of 0.1 r for an 8-hr day (*1, 4*), the dosage rate per hour would be 12.5 mr (0.0125 r/hr). The dose of radiation for multiple exposures that can be tolerated by the fingers has not definitely been determined; therefore, it is being assumed that a dosage rate of 12.5 mr/hr is a permissible amount. Under these conditions, if one were to receive this permissible dose on his hands, each square centimeter of area will have been struck by 4×10^5 beta particles. This fact must be taken into consideration when handling an ordinary Erlenmeyer flask containing a solution of radioactive phosphorus.

To substantiate the existence of this radiation hazard, measurements were taken of the radiation emitted from a 125-cc Erlenmeyer flask containing 100 cc of distilled water to which various amounts of P^{32} were added.

Readings were taken in mr/hr by means of a glass beta-gamma counter tube having a wall of 30 mg/cm^2 approximately 0.12 mm thick. The counter was placed at an angle of 45° with the liquid level and at a distance of 15.0 cm from the angle formed by the meniscus and the side of the flask.

It was found during this investigation that the wall thickness of several flasks was not the same and that variations in the amount of emerging radiation were as great as 30%. Also, as any one flask was rotated, the amount of emergent radiation varied, indicating uneven thickness of the glass in various areas.

Table 1 shows the amounts of P^{32} in millicuries that were added to the 100 cc of distilled water and the average mr/hr as measured at a distance of 15 cm. The values listed in the column headed "1.5 cm" were calculated by the inverse square law. Those given in the column headed "On flask" were obtained by extrapolation from a graph of mr/hr vs. distance.

[1] The radioactive phosphorus used in this investigation was supplied by Clinton Laboratory and obtained on allocation from the U. S. Atomic Energy Commission.

The work was supported in part by Office of Naval Research.

[2] The authors gratefully acknowledge the assistance of Kathryn H. Haley and Charles K. Spalding.

From Table 1 it is readily seen that a solution containing 1 mc (1,000 μc) of P^{32} is emitting 56 times the permissible amount per hour through the flask at zero distance. The allowable handling time for a flask under these conditions would be 8.5 min, since in this length of time one's hands would have received a daily dose.

TABLE 1

RELATION BETWEEN VARIOUS CONCENTRATIONS OF P^{32} AND THE AVERAGE MR/HR AT SEVERAL DISTANCES

P^{32} (mc)	Average mr/hr at		
	15 cm	1.5 cm	On flask
0.5	2.2	284	450
1.0	3.6	475	700
1.5	5.3	703	1,100
2.0	7.0	925	1,500
2.5	9.2	1,210	1,900
3.0	11.0	1,450	2,300
3.5	12.8	1,690	2,700
4.0	14.3	1,880	2,920

Fig. 1 has been drawn from the data shown in Table 1 and may be used as a guide for determining the length of time a flask of this type can be safely handled when it contains various concentrations of radioactive phosphorus.

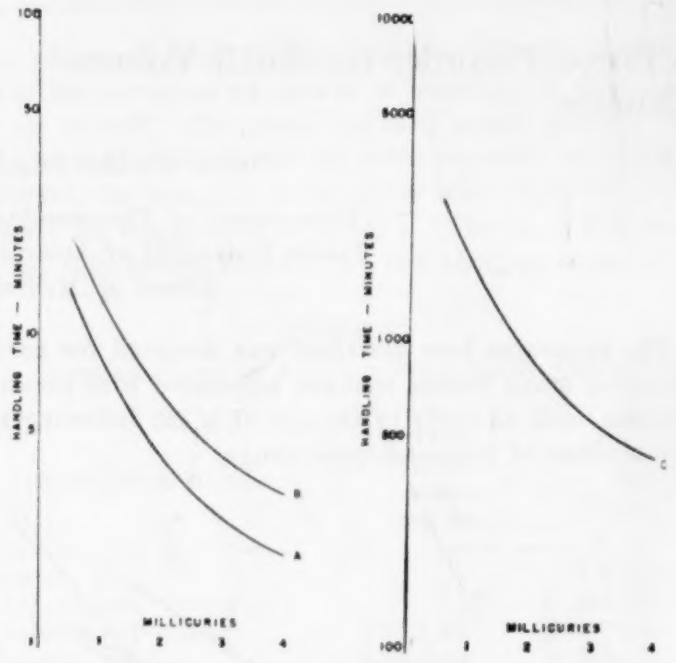


FIG. 1. Handling time for various concentrations of radioactive phosphorus. Curve A indicates the handling time when one grasps the flask barehanded. Curve B is to be used when the distance from hand to flask is only 1.5 cm. Curve C shows the handling time at a distance of 15 cm from hand to flask.

References

1. AMERICAN STANDARDS ASSOCIATION. Safety Code for the Industrial Use of X-Ray.
2. CORK, J. M. *Radioactivity and nuclear physics.* New York: D. Van Nostrand, 1947. Feather rule, p. 121.
3. EVANS, R. D. *Nucleonics,* 1947, **1**, 32–43.
4. HENSHAW, P. S. *Radiology,* 1945, **44**, 569–580.
5. MARINELLI, L. D., QUIMBY, E. H., and HINE, G. J. *Amer. J. Roent. Rad. Therapy,* 1948, **59**, 260–280.

Using Radioisotopes?

P-32

I-131

Na-24

Ca-45

Showing the Autoscaler and Lead Shielded Geiger Tube being used to measure uptake of radioiodine.

then investigate

THE TRACERLAB SC-1A AUTOSCALER

A proven instrument in the modern clinic and laboratory, the Autoscaler and its numerous medical accessories are designed to the exacting requirements of the physician investigating thyroid problems with radioiodine, arteriosclerosis with radiosodium, polycythemia vera with radiophosphorus, and many others.

This valuable adjunct to your laboratory is available at a new, low price of only $650.00 complete with preamplifier. The new TGC-1/1B83 end-window Geiger tube and removable lead shield for improved directional counting are only $77.50 additional!

Contact Tracerlab today and allow us to assist you in any of your problems in radiochemistry, health physics, or instrumentation. Our free monthly publication, Tracerlog, will keep you up-to-date on developments in this new field. Write for it now!

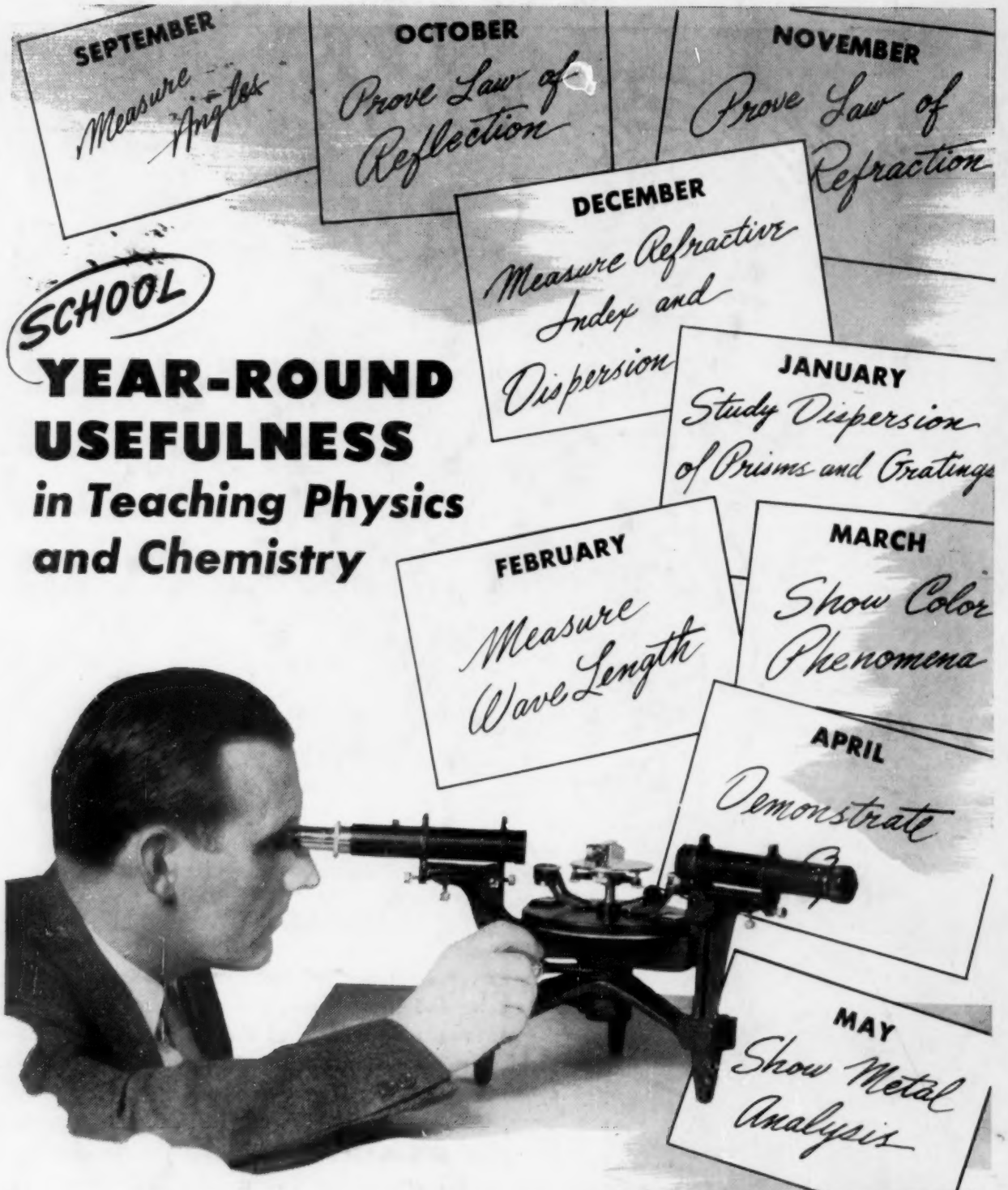
All prices f.o.b. Boston.

Tracerlab

Commercial Radioactivity Center

instruments • isotope processing • tracer analyses
industrial applications • research

TRACERLAB INC., 57 OLIVER STREET, BOSTON 10, MASS.



SCHOOL

YEAR-ROUND USEFULNESS

in Teaching Physics and Chemistry

The Spencer Spectrometer adds interest to classroom demonstrations throughout the year. With its accessories — spectrographic camera, spectroscope, condenser, comparison prism, and 2-aperture diaphram —this versatile instrument demonstrates many principles dramatically and instructively, in chemistry as well as physics classes.

For complete information about the Spencer Spectrometer, write Dept. E5.

American Optical
COMPANY
Scientific Instrument Division
Buffalo 15, New York

Manufacturers of the **SPENCER** *Scientific Instruments*